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Pruning

HARDY FRUIT PLANTS

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U. S. DEPARTMENT OF AGRICULTURE

ALTHOUGH pruning is one of the oldest horticultural practices, the principles on which it is based are not well understood by many orchardists and gardeners.

Pruning should always be done with a specific purpose in mind. That purpose may be the shaping of the plant or the renewal or invigorating of fruiting wood.

A good rule in pruning is to cut no more than is necessary to accomplish the specific purpose, as overpruning is in general more injurious than underpruning.

The purpose of this bulletin is to outline briefly the general principles on which pruning of fruit trees is based and to suggest methods of pruning and training that have proved satisfactory in orchard, vineyard, and berry-field management in nearly all parts of the United States.

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PRUNING HARDY FRUIT PLANTS

Prepared in

Crops Research Division, Agricultural Research Service¹

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INTRODUCTION

Pruning fruit-bearing plants has been practiced since the earliest days of fruit culture and is generally recognized as one of the important steps in commercial orcharding. Too often, however, pruning has been done without a clear perspective of just what its effect will be on the tree or vine and on the crops of fruit. The purpose of this bulletin is to outline briefly the general principles on which pruning of fruit plants is based and to suggest methods of pruning and training that have proved satisfactory in orchard, vineyard, and berry-plant management in nearly all parts of the United States.

The detailed pruning methods to be followed will vary somewhat in different areas of the United States. For example, in the very cold northern Plains area fruit trees are frequently trained to bush form to obtain added protection from winter cold. Such a practice, which is very valuable for those particular conditions, would not have general application over the whole United States. The extent of pruning which is desirable may also vary in different sections and with different growing conditions. In general, pruning is considerably heavier in the irrigated sections of the West, where fruit plants grow very vigorously, than with the same kinds of plants in unirrigated sections of the country. However, the basic factors to be considered in pruning do not differ greatly in the various sections of the United States.

PRUNING FRUIT TREES

In pruning fruit trees, the orchardist should have a definite plan in mind whether the trees are young or old. A good rule is to prune only as much as is necessary to accomplish the specific purpose of the

¹ The section on pruning apples and pears was written by J. R. Magness, horticulturist; that on stone fruits by F. P. Cullinan, horticulturist; that on grapes by C. A. Magoon, formerly bacteriologist; and that on berries and other small fruits by George M. Darrow, formerly horticulturist. The section on "Treatment of Wounds" (p. 4) is based largely on results of investigations by J. S. Cooley, formerly pathologist.

pruning. Overpruning is generally more serious than underpruning with nearly all fruit trees. In general, apple, pear, sweet cherry, plum, and prune trees require less pruning than peach and sour cherry trees.

The purpose of pruning young, nonbearing trees is primarily to shape the trees so that the main scaffold branches will be well distributed up and down and around the trunk. This is the surest way to avoid bad crotches that may result in breakage later in the life of the tree. Careful selection of the best scaffold limbs early in the life of the tree should also make it possible to avoid most large cuts later and thus reduce the hazard of the entrance of wood-rotting fungi into the older tree.

In general this early shaping of the tree should be accomplished with the smallest possible amount of pruning. Experimental evidence has shown that the more severe the pruning of the tree prior to bearing age, the longer the time of bearing is delayed and the smaller the tree will be at any given time. Trees that receive little pruning from time of setting until they reach bearing age are almost invariably larger and fruit earlier than heavily pruned trees of the same age. Thus, because pruning tends to be a dwarfing process and to delay bearing, the shaping of the tree during its early life should be accomplished with the minimum amount of cutting.

In pruning bearing trees the grower should have various objectives in mind. As the trees become older, the tops may become too thick for satisfactory spraying. Much weak-growing wood may develop throughout the tree which never produces fruit of satisfactory size and quality. Such wood should be removed by pruning. With many fruits during favorable crop years the trees tend to set far more fruit than they can develop to good size and quality. Pruning the trees tends to reduce the amount of fruit without proportionately reducing the foliage system; thus pruning may partly displace fruit thinning. This is particularly true of trees such as the peach, which produces fruit largely on wood of the previous season's growth. Pruning reduces the number of buds and growing points in the top of the tree without reducing the root system. It tends to stimulate growth in the remaining parts of the tree, particularly if the pruning consists in removing numerous small twigs and branches throughout the top. Removing a few large limbs will have very little effect on growth in the remainder of the tree, but numerous small cuts will stimulate growth in the remaining twigs and branches.

Thus the primary objective in pruning bearing trees is to keep the tops sufficiently open to permit efficient spraying and other orchard operations, to remove the weak-growing wood, and to assist, along with proper fertilization and other soil management practices, in maintaining a good growth condition in the trees. Within limits, the pruning of mature trees may also prevent them from growing too tall, and thus facilitate spraying, fruit thinning, and picking.

TIME OF PRUNING

Twenty to twenty-five years ago it was frequently recommended that some pruning be done in the summer. However, experimental results have indicated that summer pruning tends to be even more of a dwarfing process than winter pruning, and in recent years summer

pruning both of young and bearing trees has largely been discontinued. At the present time dormant season pruning is practiced almost exclusively in American orchards.

An important question with orchardists, however, is when during the dormant season should the pruning be done. Apparently there is little difference in the response of the tree from early or late winter pruning so long as it is done at a time when there is no foliage on the tree.

When very severe freezing temperatures occur, injury to the trees is likely to be more serious if they have been pruned prior to the freezing weather. Thus in parts of the country where very low temperatures are likely to occur, it is safer to postpone the pruning until danger of severe temperatures is past. With fruits that are subject to bud killing by low winter temperatures, such as peaches, it is usually good practice in the colder districts to postpone the pruning until danger of severe freezing is past. Then, if many of the buds have been injured, the pruning can be relatively light; if few, it can be relatively heavy.

If the pruning is postponed until new growth has started, it is much more of a devitalizing process than if done before the buds break. The first growth on fruit trees is formed primarily from the food storage reserve in the plant and is extremely rich in nitrogen. When the pruning is done prior to the start of growth, most of these food reserves are diverted to the buds that remain; if it is done after growth has started more of the food materials will be cut off from the tree with the wood and the new growth that is removed, and the pruning does not stimulate growth in the remaining buds to the same extent as if done while the trees are dormant.

HEALING PRUNING WOUNDS

Tree wounds heal as a result of callus formation from the cambium, the region of active cell growth between the bark and the wood. The growth of callus is dependent upon the food material formed in the leaves, which moves down through the bark. Thus the greater the leaf surface above the wound, the more rapid the callus growth and healing. All pruning wounds should be so made that there is a good leaf-bearing tissue beyond the cut. Thus a limb 2 inches in diameter, cut smoothly from the side of a large branch, should heal over completely within 3 years. A wound of similar size with only a small leaf-bearing area beyond will require many years to heal. A limb cut off leaving a stub of 2 or 3 inches or more never heals, but the stub finally dies unless a shoot forms from the cut end. Thus all cuts should be made close to the trunk or limb from which the branches are removed. If this is done, pruning wounds on young trees will heal promptly and without danger of wood-rotting fungi invading the tissues.

If the scaffold limbs are carefully selected while the trees are young, there should be a minimum of limbs to remove as the trees grow older. There is relatively little danger of infection in pruning wounds where the limb removed is not more than $1\frac{1}{2}$ to 2 inches in diameter if the cut is properly made. When the tree becomes older and the main limbs larger, 3 inches or more in diameter, removal of such limbs is

likely to result in wood-rotting fungi gaining entrance into the main tree. Thus, it is particularly important that a careful selection of these main scaffold limbs be made while the tree is young so that overcrowding may be avoided later on. However, even after the most careful shaping of the tree, large limbs may require removal because of breakage or for other reasons. In many of our present bearing orchards such a careful selection of scaffold limbs was not made, and it may become necessary to remove limbs after they are several inches in diameter.

TREATMENT OF WOUNDS

Results from experiments made by investigators in the United States Department of Agriculture on apple trees each month during 7 years strongly support the common belief that pruning wounds made in early spring heal better than those made at any other time in the year. Fall or winter wounds may or may not heal normally, depending upon the vigor of the tree and subsequent weather conditions. A severe cold spell sometimes causes great enlargement of fresh pruning wounds, the bark surrounding fresh wounds being much more sensitive to cold injury; sometimes the injury is more general, involving the entire tree.

Fungi may invade an open wound at any time until it is completely covered by callus, therefore the sooner it heals the better the protection. Wound dressings may be used for temporary protection. In the studies conducted by the Department many experimental wound dressings were devised and used together with commercial or proprietary preparations. Most of the materials tested were more harmful than beneficial. Callus growth is decreased under thick, impervious dressings, possibly because of impaired aeration; also open blisters or cracks in the dressing often result from pressure of sap and callus growth, leaving rough open cavities for entrance of fungi and woolly aphis. Dressings containing disinfectants may inhibit callus formation or even enlarge wounds by killing surrounding tissue.

Two wound dressings that gave good results are common shellac and one made by heating together 8 parts by weight of resin and 3 parts by weight of sardine oil or raw linseed oil. This wax dressing may be warmed and applied like paint. Nearly as good results were obtained in spring applications on fresh pruning wounds by thinning the dressing with lead-free gasoline to the consistency of thick paint. Almost all dressings slightly impaired the first season's callus growth if applied immediately on fresh wounds, but the damage was greatly reduced in the case of nontoxic dressings by waiting a week or more before coating the wounds. As the dressings used did not remain in good condition more than a year, annual renewal was needed.

It seems doubtful whether covering pruning wounds is economically desirable except for large wounds on valuable trees. In such cases, at least annual renewal of the wound covering is necessary for effective results. The use of noninjurious wound coverings will not increase the rate of healing, but they may aid in preventing the entrance of wood-rotting fungi. Such materials as lead paint, creosote, and many of the proprietary wound-dressing materials have retarded callus formation.

PRUNING TOOLS

Three tools are essential for pruning: A good pair of pruning shears for making small cuts up to one-half inch in diameter; lopping shears with 24- to 30-inch handles, suitable for cuts up to 1 inch in diameter; and a good pruning saw, several types of which are available (fig. 1). A fourth tool, valuable for use on large trees, is the pole pruner, with cutting parts on the end of a rod 6 to 12 feet in length.

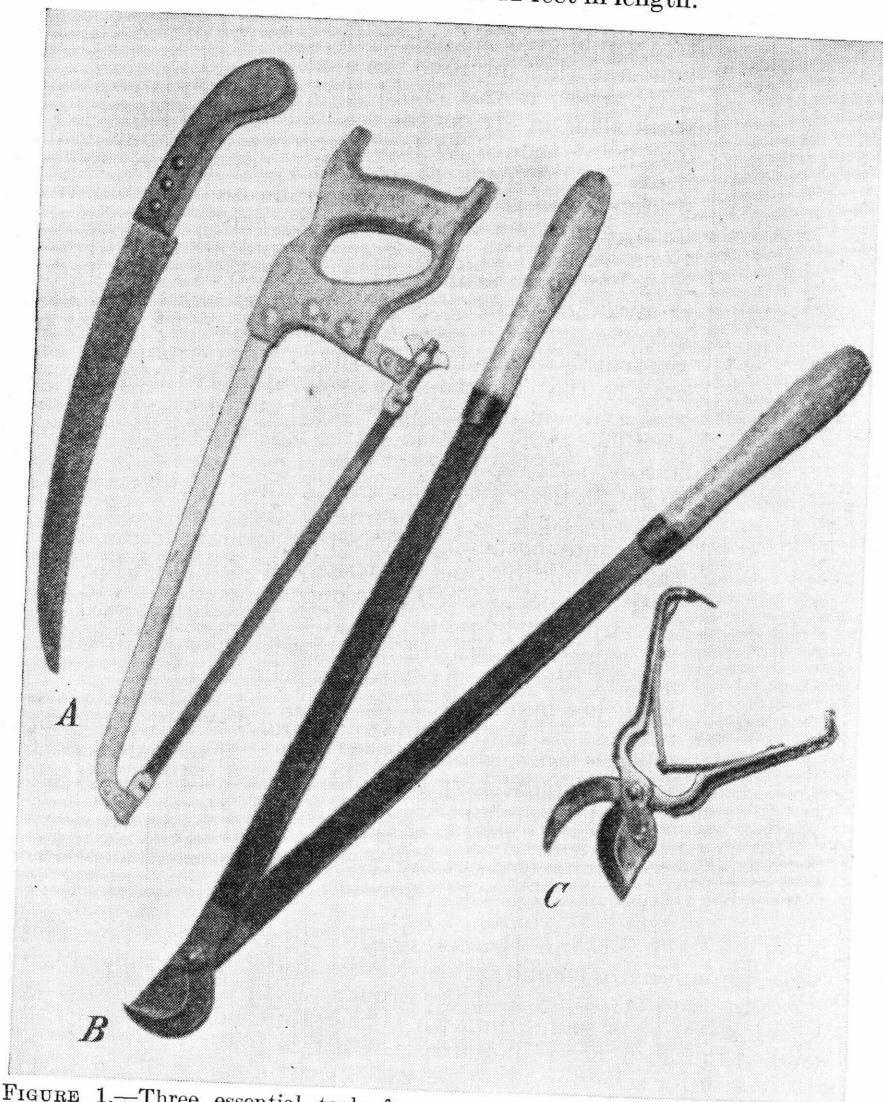


FIGURE 1.—Three essential tools for pruning: A, Pruning saws; B, lopping shears; C, hand shears.

PRUNING APPLE AND PEAR TREES

Pruning the tree during the first 4 or 5 years it is in the orchard is more important from the standpoint of determining its structure and strength than any later pruning. From the time the tree is started it

is necessary for the grower to have in mind the general type of tree that will have maximum strength in the framework of its branches and bear a crop of fruit with least breakage.

At the beginning of the twentieth century the so-called open or vase-type tree was much in favor. In building this type of tree the main scaffold limbs were taken from near one point on the trunk. The natural central leader of the tree was removed, and several more or less equal scaffold limbs were developed. It was thought that this type of tree would give the maximum exposure of the fruit to light and thus improve the quality.

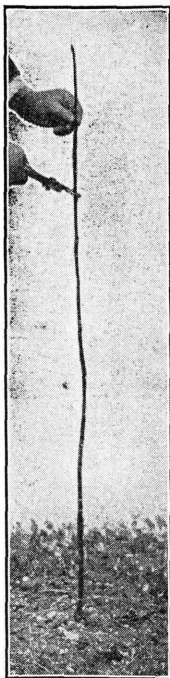


FIGURE 2.—A 1-year-old Stayman Winesap apple tree being pruned immediately after planting.

However, it was found that such trees were very weak structurally, as the scaffold limbs originating at one point tended to form crotches that split apart when heavy loads of fruit developed; also, heavy pruning was required to maintain the trees in this form, and their total bearing capacity was reduced. Consequently in more recent years apple and pear trees have been pruned almost exclusively to the leader or modified-leader type. This gives a stronger tree structurally with greater bearing capacity. Most of the fruit is borne on the outer part or periphery of the tree, so that the crop is as well exposed to light with this type of tree as with the vase form. Only the modified leader or leader tree is discussed in the following paragraphs.

By the leader type of tree is meant one in which a central trunk is maintained. (See figs. 2 and 3.) The limbs branching off from this main leader in all cases should be smaller at the point of union than the leader branch. Such a union has been found to give the strongest possible type of crotch. Also, the wider the angle at which the side branch takes off from the central leader, the stronger the resulting crotch. Branches taking off at narrow angles tend to split out, whereas those with wide angle crotches taking off from a larger leader almost never split. Such branches may break from a heavy load of fruit, but they do not split out from the main trunk.

The ideal tree is also one in which only one side branch develops at the same height on the trunk of the tree. If the main side branches develop along the trunk at points at least 6 inches apart, the strongest possible tree will develop. In addition to a good distribution along the trunk, main limbs should be as well distributed as possible around the trunk. It is necessary that the pruner visualize how the tree will look not when it is young but when the main side branches have developed to 3 to 6 inches in diameter. If this point is kept in mind, the necessity for selecting branches well spaced along and around the trunk will be appreciated.

Pruning the Young Apple and Pear Tree

When the young tree is received from the nursery it may be an unbranched "whip" 4 to 6 feet tall. This is usually the case if trees

1 year from the bud are planted. Certain varieties such as York Imperial may have well-developed side branches even on 1-year-old trees; 2-year-old trees from the nursery usually have a number of side branches when received.

One-year whips should be headed at about $3\frac{1}{2}$ to 4 feet when planted (fig. 2); if left longer they are likely to blow in the wind unless staked; if headed lower, the branches will grow mainly from near the top of the short trunk that is left and will be close together. A good selection of well-distributed main branches will not be possible following low heading. If side branches have developed in the nursery so that some

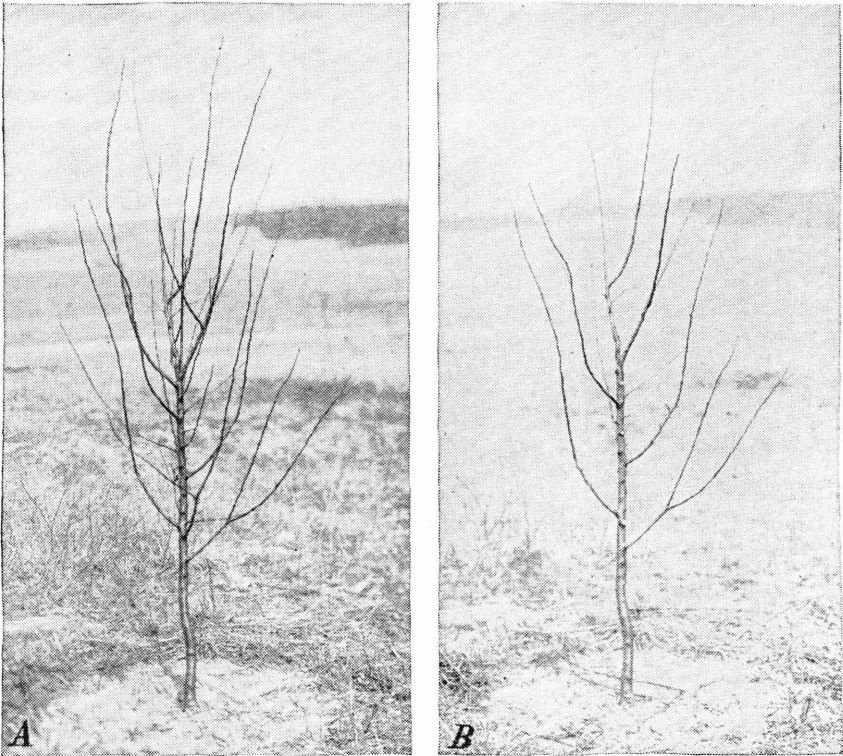


FIGURE 3.—A vigorous Delicious apple tree, grown 1 year in the orchard: A, As it appeared before it was pruned, showing ample distribution and numbers of branches for selection of scaffold limbs; B, after it was pruned. The principal scaffold limbs were all selected at the end of the first year.

of them are suitably spaced for scaffold limbs, they should be left on the tree when it is planted, and all others should be removed.

The trees can be allowed to grow during the first season in the orchard with no further pruning until the following dormant season. During the winter following the first season's growth in the orchard, the selection of scaffold branches must be made.

If the tree has been headed at $3\frac{1}{2}$ to 4 feet high and has made good growth, 6 to 12 fairly strong side branches should have developed. Usually those coming from the upper part of the tree make the strongest growth. If a good branch has developed from $1\frac{1}{2}$ to 2 feet above

the ground it can be selected as the bottom scaffold limb. Two or three additional limbs spaced at least 6 inches apart along the trunk and extending in different directions from the trunk should be retained. The topmost branch that is retained should be the strongest growing.

If the topmost branch is weak, it should be removed, and the leader should be developed from the lower, stronger growing branch.

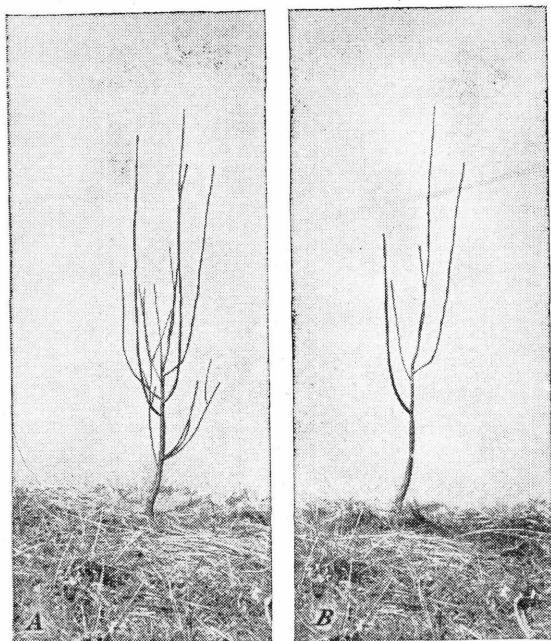


FIGURE 4.—Apple tree 1 year old in the orchard: A, Before pruning; B, after pruning. Branches developed too close together to permit full selection of scaffold limbs at the end of the first season in the orchard. Additional scaffold limbs will be selected at the end of the second growing season.

end of the first year in the orchard. Additional ones on the leader will be selected at the end of the second year in the orchard.

Unless the tree is making exceptional growth, no heading of the branches or leader is necessary or desirable. Shoots making growth of 3 to 4 feet or more may require light heading back to prevent too much blowing and whipping in the wind.

Disbudding or Deshooting Young Apple and Pear Trees

A number of investigations have been conducted to determine the value of selecting buds from which scaffold limbs are to be developed at the time the young nursery tree is set in the orchard and of rubbing off the remainder of the buds, so that only limbs desired as scaffolds would develop during the first season in the orchard. Experimental results have shown that with a limited number of branches growing during the first year the angle at which such branches join the trunk of the tree is much narrower than where a larger number of buds are allowed to grow. This is particularly undesirable with trees

It is not necessary, and in most cases not possible, to select all the main scaffold limbs at the end of the first growing season. The terminal branch that is left will throw additional strong laterals during the second year, which in turn can be used for additional scaffold limbs. Figure 3 shows a strong-growing tree of the Delicious variety after 1 year in the orchard, before and after pruning to a modified-leader type of tree. Sufficient well-distributed branches were available to make a good selection of scaffold limbs. Figure 4 shows a tree in which the branches rise too close together on the trunk to select all the scaffold limbs at the

naturally tending to grow upright. The total growth of the tree during the first year also is likely to be less with the smaller number of growing buds, although the growth from the individual buds remaining is as great, or possibly greater, following a disbudding treatment. Mainly because of the narrower crotches, this system has not come into general favor with apple trees.

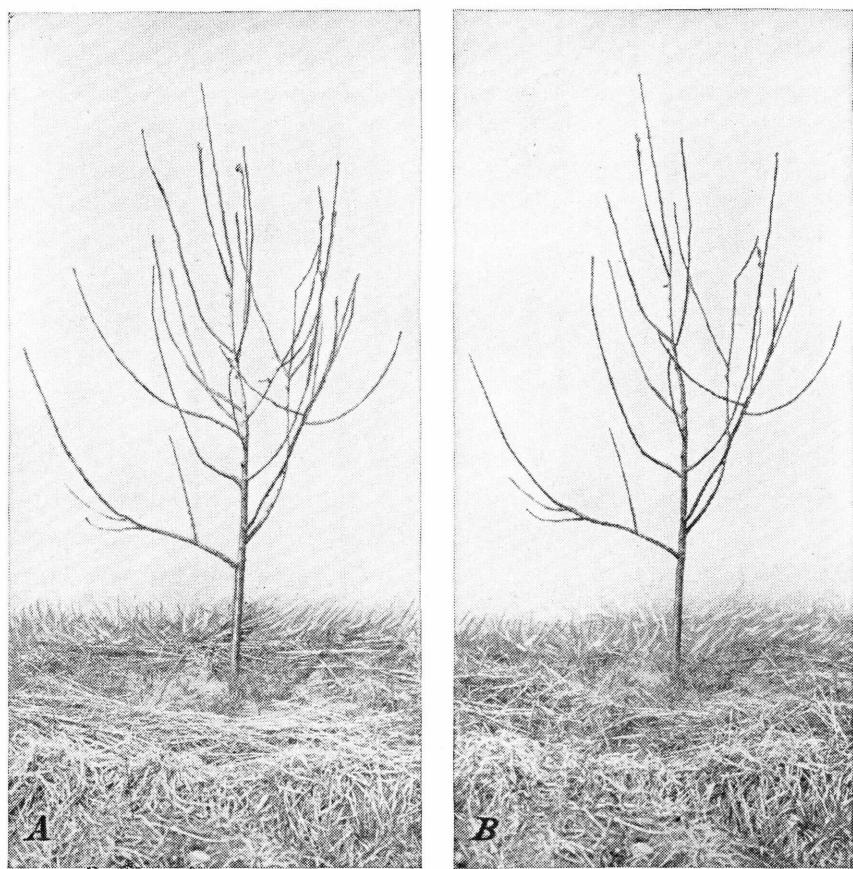


FIGURE 5.—Two-year-old Jonathan trees: *A*, Before pruning; *B*, after pruning. A good selection of branches was made at the end of the first season. Very little pruning was required at the end of the second year.

A modification of this method is referred to as deshooting. In this treatment the young shoots are allowed to grow 2 or 3 inches, then the selection is made and those not desired for scaffold limbs are cut off close to the trunk. Results from this are intermediate between disbudding and allowing the whole number of buds to develop into branches. Crotch angles are wider than following disbudding but generally narrower than if a large number of branches develop. In some cases disbudding or deshooting has been followed by using

mechanical spreaders to insure wider angles at the crotches. Excellent trees can be built by this system, but it requires a great deal of detailed attention and in the case of apples and pears is not greatly superior to allowing the buds to develop in competition during the first season and making the selections of limbs at the end of the first year.

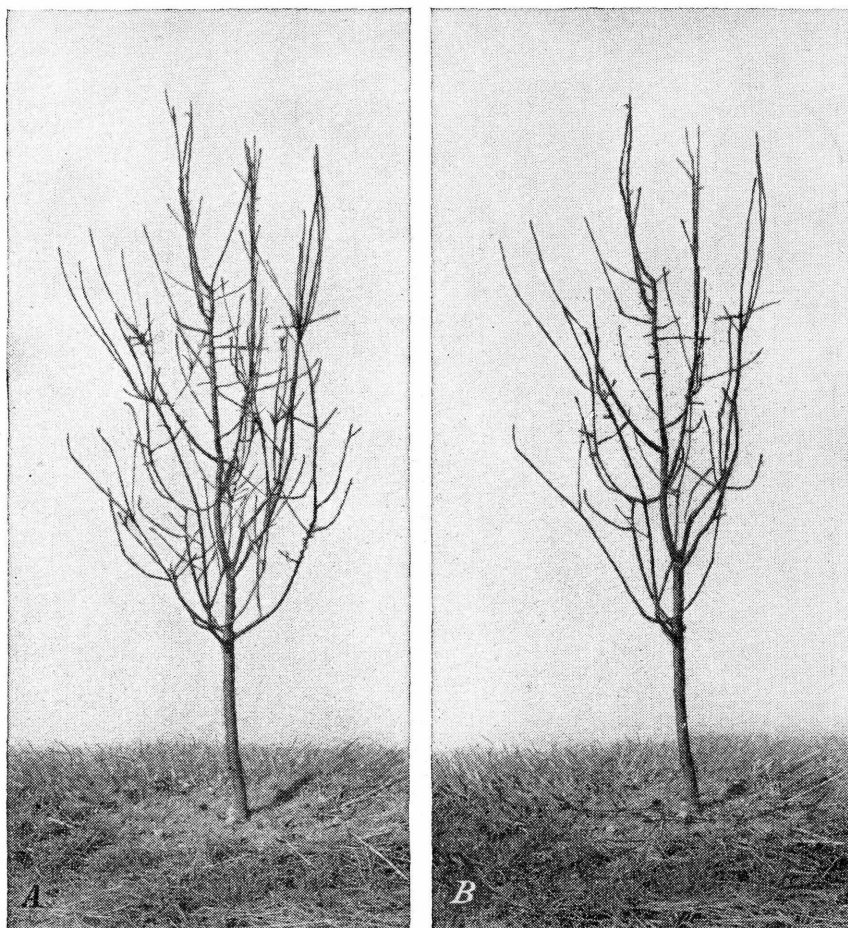


FIGURE 6.—A 3-year-old Rome Beauty apple tree (A) before and (B) after pruning.

Pruning Trees from 2 Years to Bearing

Figures 5 to 9 illustrate pruning treatments for trees 2, 3, and 4 years of age. If a good selection of branches for scaffold limbs has been made during the first 2 years, pruning during later years will consist mainly of removing undesirable sucker growth and a slight thinning out of the top. Where two branches may be making sharp and even crotches this condition should be corrected either by removing one of the branches or by suppressing its growth through heavier

pruning on one branch than on the other. With competing branches as with trees, pruning is a dwarfing process, and the more heavily pruned branch will make less growth the following year than the lightly pruned or unpruned branch. This principle should be used in correcting bad crotches. If one of the scaffold limbs becomes nearly equal in size to the trunk or leader it should be suppressed by heavier pruning in proportion to the remainder of the tree.

It should be strongly emphasized, however, that pruning during this period should be light and consist primarily of thinning out



FIGURE 7.—A 4-year-old Golden Delicious apple tree (A) before and (B) after pruning. No major cuts were required, only a light thinning out, primarily of sprouts coming from low down on the trunk or main scaffold limbs. Pruning consisted primarily of cutting out sprouts.

rather than heading back branches. The heavier the pruning through this period the longer the time that will be required before the trees begin to fruit. If the tree has been well shaped during the first 2 years in the orchard, pruning for several years following can be very light and consist essentially in removing some undesirable growth that may come into the young trees.

When the trees come to bearing, the weight of the fruit will tend to spread the tree, and it will be much more open after it has borne a few crops than it will appear to be at 4 or 5 years of age.

Pruning the Bearing Tree

The young bearing tree should receive only a very limited amount of pruning. The tree top should be thinned sufficiently to permit satisfactory spraying; but if too much fruiting wood and leaf area are removed, the total production capacity of the tree will be reduced.

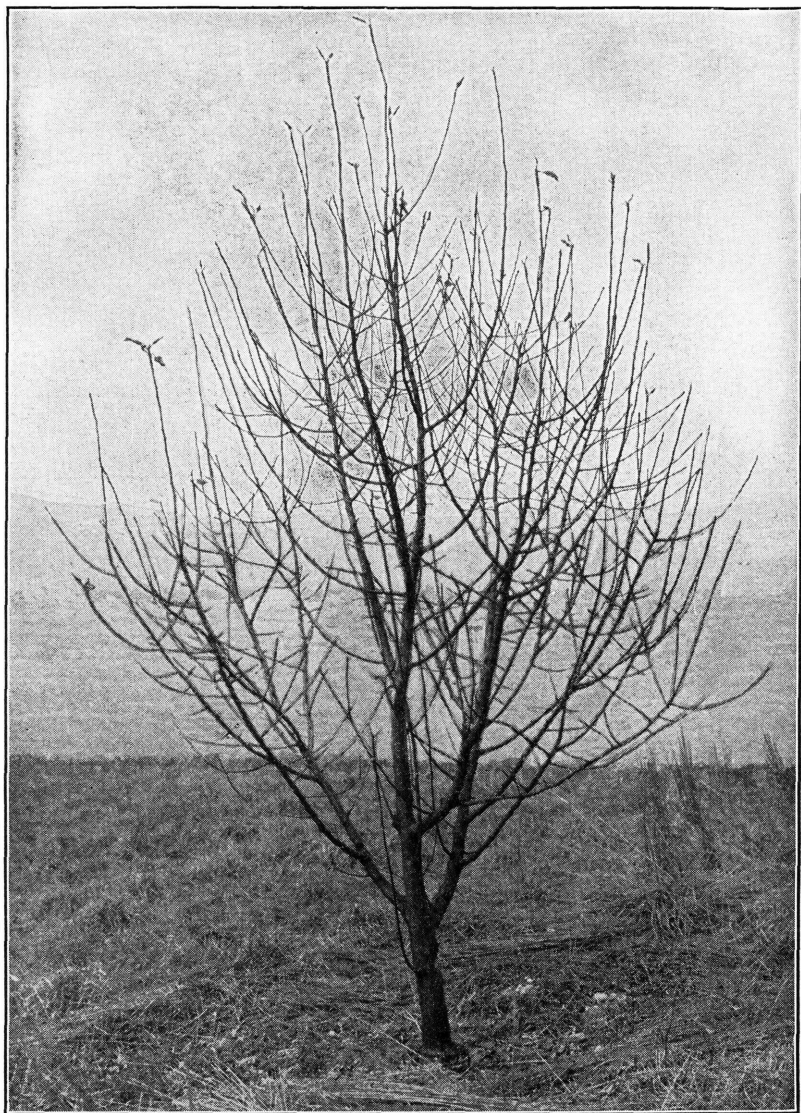


FIGURE 8.—A 4-year-old York Imperial apple tree before pruning. Pruning was primarily a thinning out of sucker growth from the trunk and scaffold limbs. A very little thinning in the top of the tree was all that was required.

As the tree becomes older, more and more weak-growing wood will tend to develop unless this is systematically removed. Weak-growing and pendent branches usually produce very little fruit,

and that produced is generally small and of inferior quality. Pruning the mature bearing tree should consist primarily in removing weak wood and in keeping the top of the tree sufficiently open to permit adequate spray coverage.

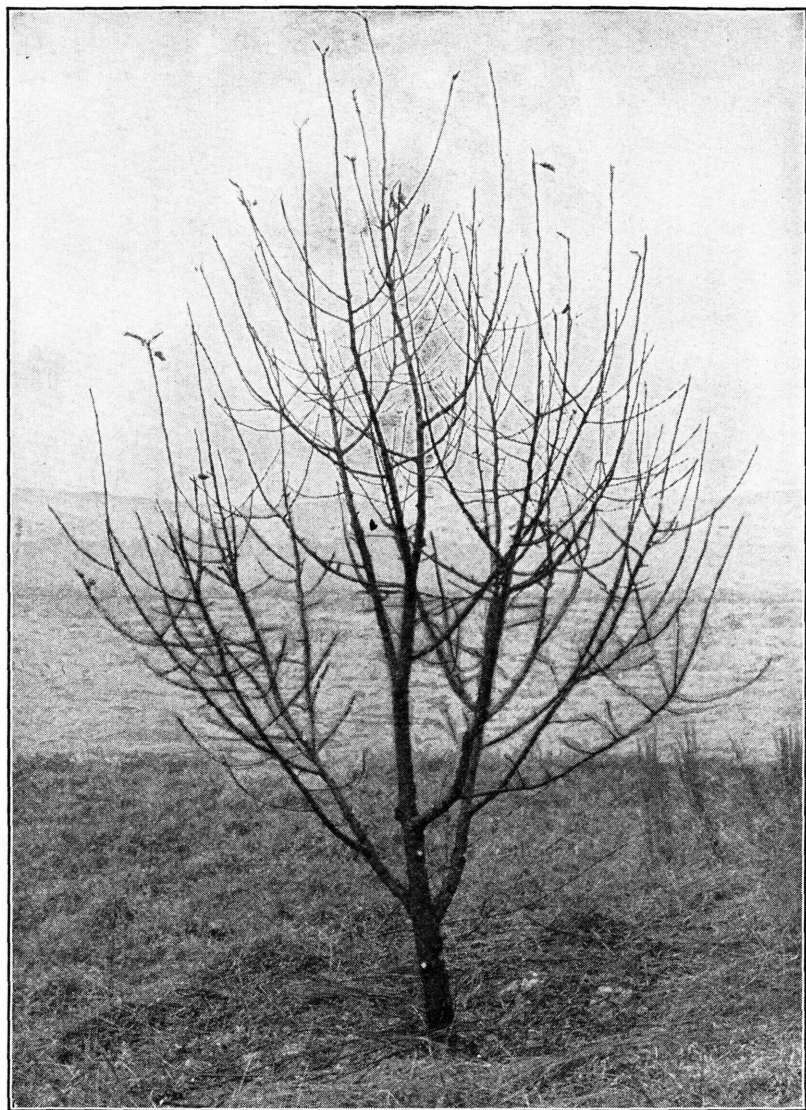


FIGURE 9.—The tree shown in figure 8, after pruning.

One problem in many orchards is to prevent the trees from becoming too tall; however, this is more a problem of tree spacing than of tree pruning. If ample space is allowed for the development of the side branches, the trees will tend to spread, and the load of fruit will tend

to keep them sufficiently low. On the other hand, if the trees are crowded, the lower limbs will be shaded out. The main growth will occur in the top of the tree, and the main fruit-producing area will be

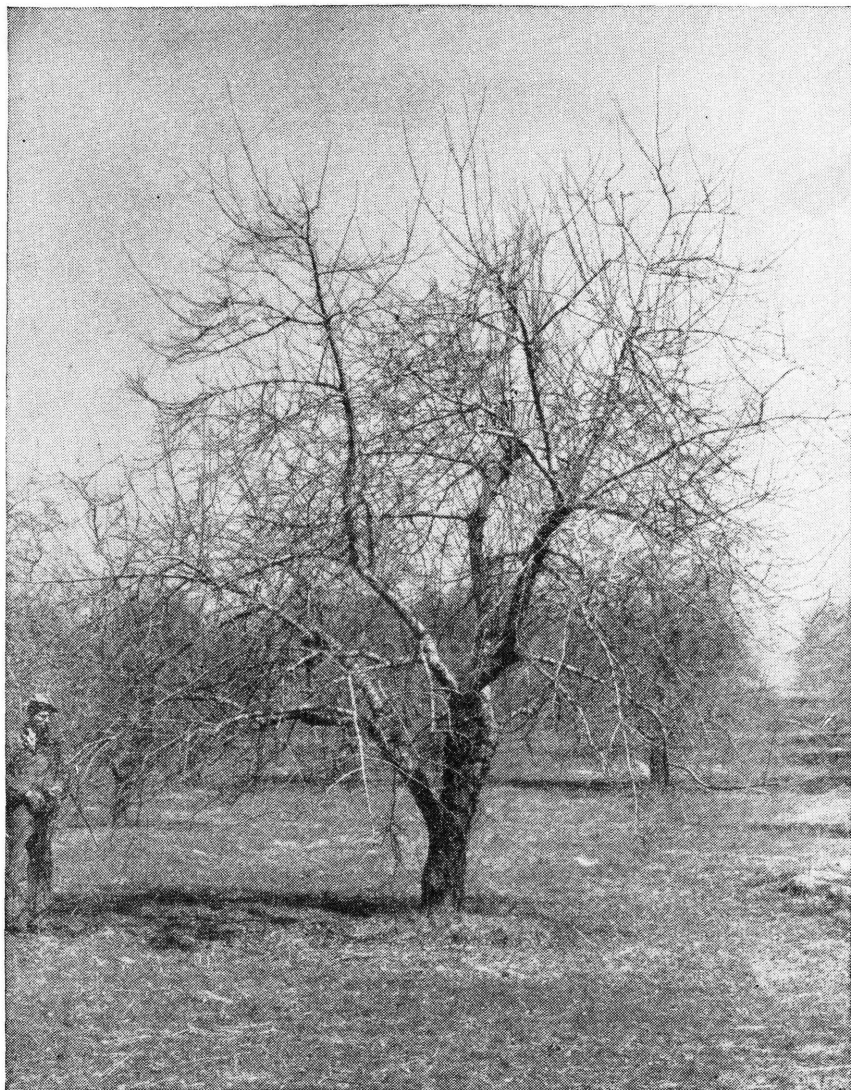


FIGURE 10.—Winesap tree unpruned for several years. The top is thick with much weak-growing wood.

high from the ground regardless of pruning treatment. Once the trees have become very high, it is difficult to appreciably reduce the height of the fruiting area without drastically reducing the total productive capacity of the tree.

Figures 10 and 12 show mature apple trees that have had little pruning for several years. The tops had become so thick that spraying was difficult, and much weak wood had developed. Pruning such

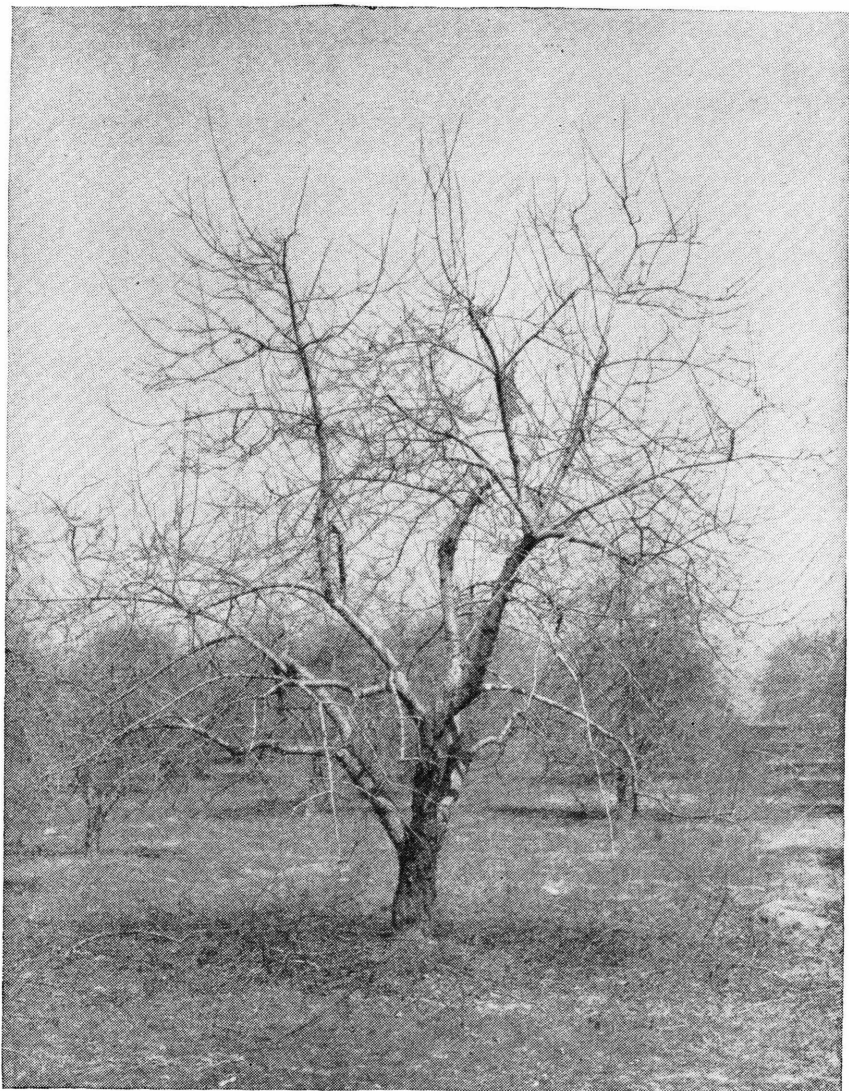


FIGURE 11.—The tree shown in figure 10 after it had been pruned.

trees should consist mainly in removing the weaker wood and thinning out the tops enough for more adequate spraying (figs. 11 and 13). Such pruning will improve the quality of the fruit produced, although usually it will not result in increased yields.

Although methods to be followed in pruning apple and pear trees are essentially similar, pruning of pears is complicated by the presence of the fire blight disease in most varieties and in most parts of the



FIGURE 12.—An old Delicious tree unpruned for 3 years. The top is too thick for satisfactory spraying and much weak wood has developed which will bear inferior fruit.

United States. Where fire blight is prevalent, frequently the removal of the dead branches will constitute all of the pruning that will be desirable. It is not possible in the present bulletin to discuss in detail the relation of pruning practices to fire blight control. Because

of the presence of this disease, however, pruning of pear trees in sections of the country where it is prevalent should be reduced to a minimum.

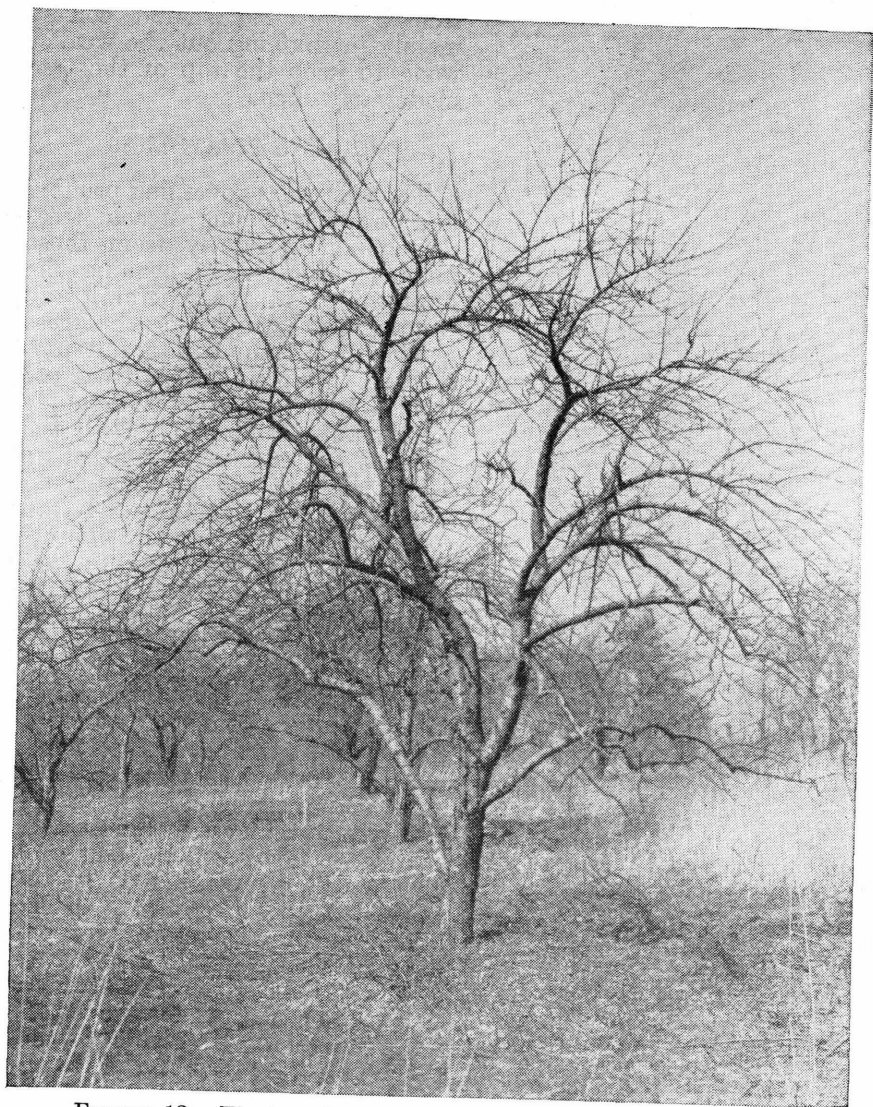


FIGURE 13.—The tree shown in figure 12 after it had been pruned.

PRUNING THE QUINCE

The quince is more of a bush grower than the apple and pear. The fruit is produced on shoots that develop during the year the fruit is borne. It is desirable, by fertilizer and pruning practices, to maintain moderate to good growth in the quince.

Because of the bush type of growth, the quince is usually headed lower than the apple and pear. The general modified-leader type of tree is desirable. Except for lower heading the young tree can be pruned essentially as outlined for apple and pear. In the bearing tree the pruning should consist mainly in thinning out the weaker wood to keep the top of the tree moderately open.

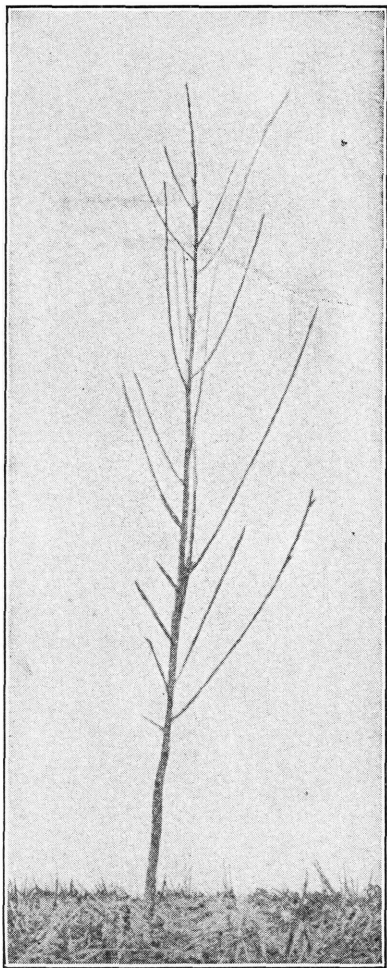


FIGURE 14.—A well-branched 1-year-old peach tree as received from the nursery, unpruned at time of planting.

PRUNING PEACH TREES

The principles governing pruning and training young peach trees do not differ greatly from those already discussed in pruning the apple and pear. In general, heavy pruning of young peach trees delays their coming into full production. Bearing peach trees are pruned more severely than apple trees of the same age. With the peach, fruit buds are produced on 1-year shoots, and pruning is an essential for trees on nearly all soils in order to insure the production of adequate shoot growth.

Peach trees are usually set in the orchard as 1-year-old trees, and the amount of cutting back to be given to the newly set tree will depend upon its size and branching. When received from the nursery, these trees are generally 3 to 7 feet in height, and the lateral branches that have been produced on the closely planted trees in the nursery are commonly not of sufficient diameter to be utilized as framework branches (fig. 14). The lateral shoots, therefore, are cut back to a single bud, in order to force the development of stronger shoots to be selected for the framework branches. In some of the peach-growing areas of the South-eastern and South-Central States June-budded trees are planted. Trees budded in June and dug the same year for fall or winter planting are usually 2 to 3 feet in height and may be branched. Frequently the side branches are too low to be utilized for the framework, and these must be trimmed off to leave a whip. Branches formed in the second year are then selected for the scaffold.

The height to which the tree is headed back is largely a matter of preference with the grower. If it is desired to keep the tree low and

spreading, the stem may be cut to a height of 18 to 24 inches (fig. 15). For convenience in working around the tree with tillage tools and performing other essential orchard operations, a higher framework of branches is preferable. Where trees are headed back to 18 to 20



FIGURE 15.—A peach tree in midsummer of its first season's growth in the orchard. When planted, it was pruned to a straight, unbranched stem 18 inches high.

inches, the scaffold branches will usually come out close together on the trunk. By leaving a longer stem at the time the tree is planted, scaffold branches may be spaced a greater distance apart on the trunk.

Peach trees have long been trained to an open center, and the scaffold branches are headed back to cause secondary branching and

to spread the head, thus keeping the tree low for fruit picking, thinning, and spraying. From the branches that arise on the cut-back tree, 4 to 5 are selected after the first year's growth and headed back to outside-growing laterals. In the second year some of the lateral shoots are thinned out, and the tips of the scaffold branches are headed back more lightly than the first year (fig. 16). Where it is desired to pick all the fruit from the ground this type of training is necessary.

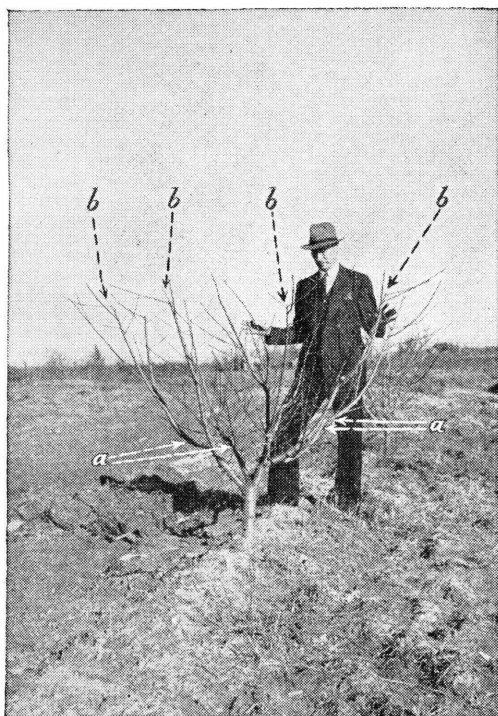


FIGURE 16.—An open-center peach tree which was headed back to 18 inches when set, as in figure 15, and has made two seasons' growth since it was planted. Four scaffold branches were selected at the end of the first year and headed back to points indicated at *a*. The terminals (*b*) were headed to outside laterals at the beginning of the third growing season, to spread the tree.

Although the open-headed type of pruning is generally practiced, peach trees can be trained to the modified-leader type. This requires more care during the first 2 years in selecting and developing scaffold branches. In order to accomplish this, trees 4 feet or more in height with a diameter of at least $\frac{7}{16}$ of an inch should be planted. These trees are then cut back to a height of 36 to 40 inches and the lateral branches are cut back to a single bud (fig. 17, A). New shoots will arise from these buds, from which the scaffold branches may be selected. These scaffolds may be selected by de-shooting during the first growing season (fig. 17) but usually the most satisfactory method is to select the scaffold branches during the dormant period, following the first growing season. Four to five branches, well-spaced

on the trunk, are selected so that no branch is directly above a lower branch.

Following the second year of growth, the pruning should usually be very light. It will consist of correctional pruning in cutting back the tip to an outside branch to keep the scaffold branches growing in the proper direction and to remove any surplus branches that have arisen on the trunk. During the third and fourth years this same correctional pruning should be done and only the competing branches that interfere with the proper development of the main scaffold removed. Some of the small shoots should be left on the inside of the tree, as the first fruits are produced on these shoots. Treatment

during the first 3 years is largely that of developing the framework of the young tree. Some varieties may require little correctional pruning; varieties that grow upright may need more tipping at the ends of the branches to spread them and to keep them growing outward. Where it is necessary to head back a scaffold branch in order to change its direction, the cut should always be made to an outside lateral

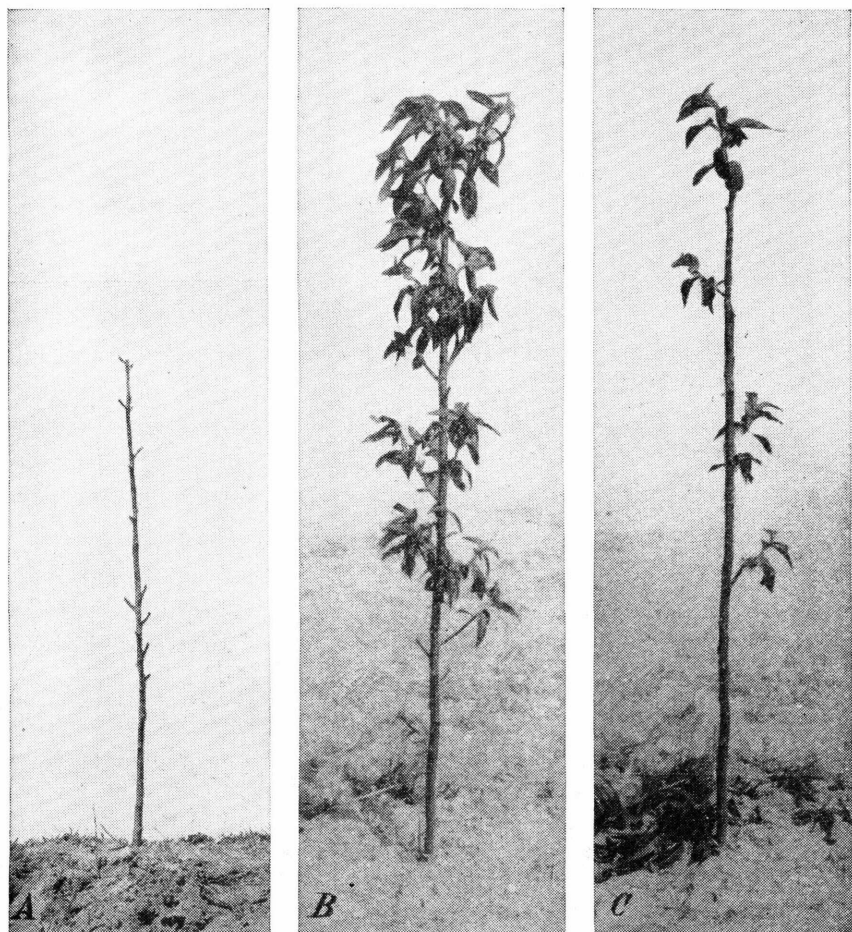


FIGURE 17.—A 1-year-old peach tree: *A*, Headed back to a height of 40 inches and the lateral shoots cut back to a single bud; *B*, 3 weeks after it started growing; *C*, after the branches for the framework of the top had been selected and the others cut off close to the trunk.

branch growing away from the center of the tree. Where this type of pruning is followed, a 4-year-old tree will be quite open and have a good growth of fruiting wood throughout (fig. 18, *A*). From the fourth to the eighth year the pruning is largely corrective, removing surplus branches growing from the scaffold limbs and heading back to outside laterals (fig. 18, *B*).

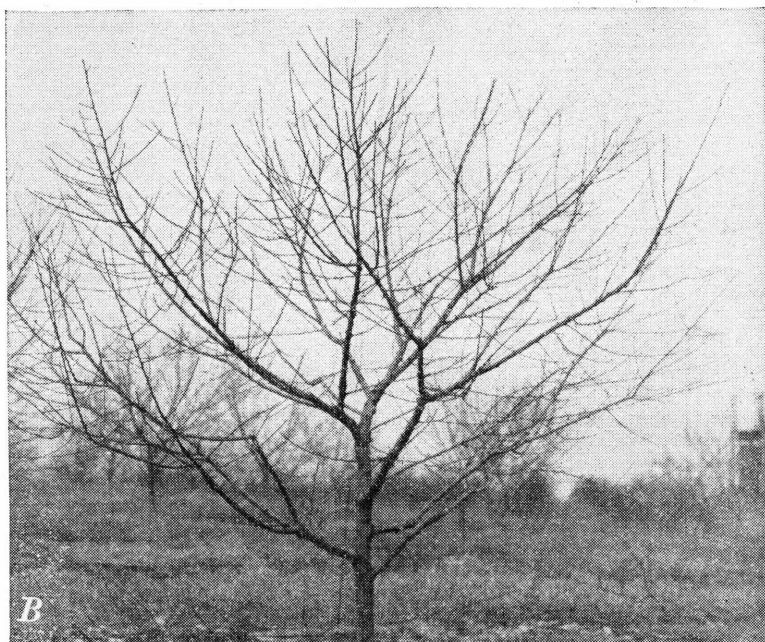
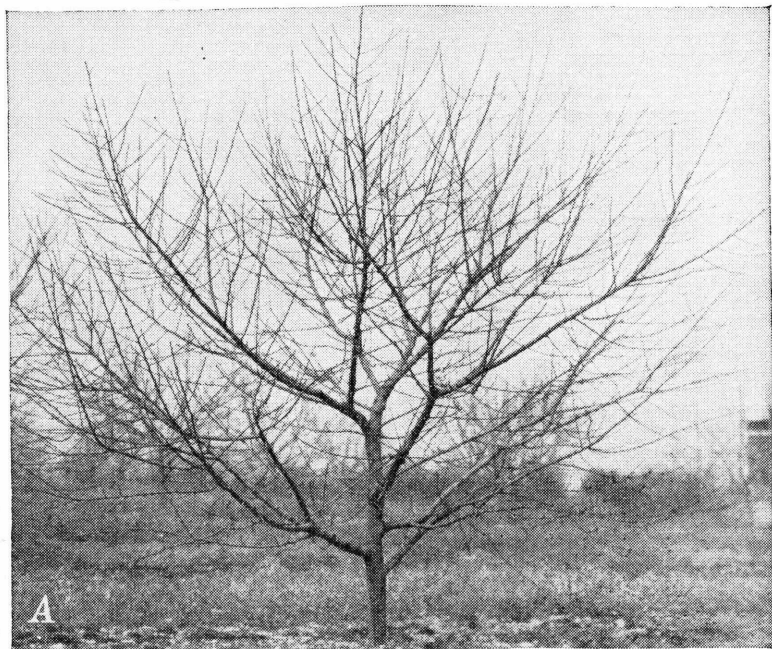


FIGURE 18.—A 4-year-old peach tree that was headed back at time of planting to a height of 40 inches, as illustrated in figure 17. Two small scaffold branches have been left on the right in addition to the four main branches originally selected. *A*, The tree before and, *B*, after pruning. Note that the pruning given at this age consists principally of thinning out the inside shoots.

The Bearing Tree

As previously stated, the pruning given bearing peach trees is heavier than that given apple trees of the same age. In order to maintain satisfactory terminal growth—12 to 16 inches a year on peach trees 8 to 12 years of age—it is usually necessary to do some heading back and thinning out regardless of the type of early training. This results in the stimulation of new growth; as peaches are borne on 1-year wood, pruning should be directed toward the production of an adequate amount of new wood, well-distributed throughout the tree. This type of pruning does not imply a general heading back. Where the ends of all the scaffold branches are headed back into 2- and 3-year-old wood, the production of terminal shoots may be very dense and shade out new growth in the tree. Such pruning also necessitates considerable spring pruning, particularly thinning the following year, in order to reduce the number of shoots. When peach trees are not pruned annually the terminal growth may be short and the vigor of the tree reduced.

As peach trees grow older they often slow up in terminal growth even though well fertilized. The shoot growth is then often only a few inches long, and the fruit will be borne on short spurlike growths. Trees of this type that have been well pruned and fertilized will be productive without being headed back; if they have not been well pruned they may become long and leggy and bear fruit principally at the ends of the branches. Cutting back into 2- and 3-year-old wood may be necessary under such conditions in order to rejuvenate the growth. If it is possible, these cuts should also be made to outside branches, and heading back to stubs should be avoided.

PRUNING CHERRY TREES

There are three types of cherries—the sweet, the sour, and the Duke. The sweet cherry tree is inclined to grow upright; the sour cherry is more spreading; the Duke cherry, which is a hybrid between the sweet and the sour, is intermediate in growth habit. The type of growth is taken into consideration in pruning the young tree. As obtained from the nursery, cherry trees are usually 4 to 6 feet in height. One-year-old sweet cherries may be straight whips, but sour ones of the same age are inclined to branch.

The Young Sour Cherry Tree

In starting the sour cherry, select for the scaffold framework some of the lateral branches found on the tree when it comes from the nursery. The sour cherry lends itself to training to the central or modified leader. Three or four branches, well-spaced around the trunk of the tree up and down, so that no branch is directly above a lower branch, are sufficient to start the head. The lowest branch should be at least 18 to 20 inches from the ground. These branches should be headed back about one-half their length and the top branch, or leader, left longer than the side branch. Neither the sweet nor the sour cherry makes as rapid growth as the peach in the second year, and the new shoots usually do not require heading back. Pruning during the first 5 or 6 years will be very light, being correctional in nature, to direct the growth of the main scaffold branches and to thin out some of the

shoots if they become too dense. In general, the trees should be pruned lightly during the first 6 or 7 years. When they are 8 to 10 years of age or older, heavier pruning by thinning out may be necessary to prevent the shading of inside twigs and to encourage the development of new growth in the center of the tree. If the trees have been making vigorous growth and are getting tall, heading back some of the upright branches to outgrowing branches will hold the tree in bounds. Keeping the trees more open also facilitates spraying.

The Sweet Cherry Tree

Because the sweet cherry tree, represented by such varieties as Napoleon, Black Tartarian, and Schmidt, is inclined to grow upright, no attempt to change this natural habit of growth should be made by pruning. The 1-year-old sweet cherry is pruned to a whip. Some sweet varieties may have one or two lateral shoots that can be utilized for framework branches. The 2-year-old trees are usually well-branched. After the first year only thinning and correctional pruning to maintain the balance in growth of the scaffold limbs are necessary. No heading back of these scaffold branches should be practiced unless the growth is exceptionally long and willowy, when heading may be desirable to keep the branches balanced and to cause the formation of secondary shoots. Even under these conditions the lateral branches will stiffen up, and the trees will make good heads as soon as more wood is laid down and the diameter of the shoot increases. As the trees come into bearing they require very little pruning.

Since sweet cherries are more susceptible to winter-killing than the sour ones, it is sometimes necessary to remove dead and injured branches. In regions where winter-killing of wood is a factor, it is important to grow trees with well-spaced scaffold branches. In the open-head type of tree where the branches all arise close together, winter-killing of wood may occur in the narrow angles at the base of the branches. Killing the wood at this point, resulting in splitting the bark, makes an opening where wood-rotting fungi may become established and thus shorten the life of the tree.

PRUNING PLUM TREES

Plum trees vary more than peach and cherry in habit of growth. Many of the important commercial varieties, as well as those used in the home garden, belong to different groups or species. The European or domestica plums, which make up the greater number of the commercial varieties, for the most part are upright in growth habit, especially when the trees are young. The Japanese varieties are either upright or more spreading, like the peach. The damson group is very upright and is less inclined to spread than the European. Plum trees as obtained from the nursery are usually branched, and the scaffold branches can be selected from those found growing on the trunk. The plum tree lends itself very well to the modified-leader type of training already discussed for the apple and the cherry. Three to four branches, and usually not more than five, will be sufficient for starting the head of the tree; if too many are left, the head becomes very dense. Because spraying is very important in the control of plum diseases, the more open type of tree is to be preferred.

The European and damson types, which tend to grow upright, will

require very little heading back. The pruning will be principally of a thinning-out nature. Certain varieties that may become very twiggy and dense will require some thinning out. Very frequently large water sprouts, or suckers, grow on the European and damson types, and it will be necessary to remove them each year, maintaining only the scaffold branches and the laterals that develop thereon. Heavy thinning of shoots should be avoided on young, vigorous plum trees, as this encourages the development of more excess shoots on the tree. In general, the bearing plum tree requires very little pruning, as fruit is produced on vigorous spurs on wood 2 years old or more.

In the Pacific Coast States, where warm, dry summers favor heavy fruit setting and soil moisture is not sufficient for a vigorous shoot growth, unless adequate irrigation water is applied, and where large fruit is required for distant shipping, much heavier pruning of bearing plum trees is practiced than in other plum-growing regions of this country. Here rather heavy heading back and thinning out of the previous season's shoots and thinning out of small fruiting branches is practiced by many growers for the purpose of inducing vigorous wood growth. Large and regular yields of uniformly large fruit are produced only by trees that make a good growth. In orchards where irrigation water is limited or soils are poor, or both, relatively more severe heading back is needed to enable the tree to produce fruit of the large sizes. The thinning of the blossom buds that accompanies heavy pruning greatly reduces the amount of the crop.

Trees of varieties grown for prune production are pruned very little, as extra-large fruit is not required and a heavy crop is desired. Prune varieties respond to pruning much as do other varieties of plums.

PRUNING AND TRIMMING GRAPEVINES

The present discussion on pruning and training grapevines applies particularly to methods and practices adapted to growing standard varieties of American bunch grapes. These two operations, although distinct, are so closely related in practice that they are naturally considered together. The objectives sought are (1) the establishment of vigorous, well-formed vines so arranged as to facilitate cultivation and care of the vine and the maturing and harvesting of the fruit; (2) the elimination of undesirable suckers, water sprouts, deadwood, and excess canes; and (3) the maintenance of fruitfulness and quality commensurate with the vigor of the vine and the capabilities of the variety.

Numerous systems of training have been developed to meet various needs, conditions, and personal preferences. Varieties differ in their habits and vigor of growth. To assure their most satisfactory performance, different types of trellises and training procedures must be used. In certain sections of the country climatic and seasonal conditions favor the development of fungus diseases and insect pests that make necessary a system of training that facilitates rapid and thorough application of sprays. In some grape-growing areas sun-scalding of the fruit on the vine calls for particular attention, and vine-training methods have been developed to meet these needs. Ease and economy in cultivation, pruning, training, and harvesting and various other considerations have had their part in the development of procedures and practices. In the present brief discussion it is impossible to give consideration to all the various systems; therefore, a selection has

been made of the few believed to be of general application, and the discussion is confined to these.

Whatever methods are followed, three important principles must be borne constantly in mind when dealing with vines of fruiting age, namely, that the fruit is borne on shoots developing from canes of the previous season's growth; that suitable canes must be selected for

this purpose at the time the pruning is done; and that the amount of fruiting wood left on the vines must be correlated with the age and vigor of the vine so as to assure its continuous healthful development as a fruit-bearing plant.

WHEN TO PRUNE

Pruning begins properly at the time the plants are set in the ground and should be practiced annually thereafter as long as the vineyard or vines are maintained. The vines should be in a dormant condition at the time of pruning, and for this reason the winter and early spring months are most favorable for the work. Vines should not be pruned when the canes are frozen, as physical injury is very likely to occur. In northern sections of the country, pruning should not be done until danger of excessively low temperatures is past, as a hard freeze following the pruning may result in partial or complete killing of the pruned canes. In areas where extremely low winter temperatures are not encountered, pruning may be done any time after the leaves have fallen in the late fall on until early spring;

however, it should be completed before the buds begin to swell. Excessive bleeding, which occurs when pruning has been too long delayed, is to be avoided, though a little bleeding seems to do no serious harm.

Pruning during the summer months, except to remove water sprouts and suckers and occasionally to control too rampant a growth of some part of the vine, should not be practiced. The vine depends upon its chlorophyll-bearing leaves and tissues to manufacture the organic foods required to meet its present needs, to supply the carbohydrates necessary for the maturing of the fruit, and to provide the food reserves

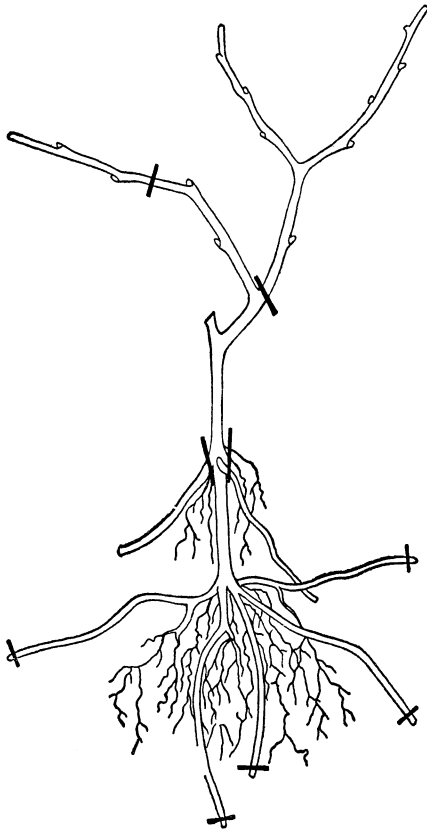


FIGURE 19.—A young grapevine as it was received from the nursery. Heavy cross marks indicate where it should be pruned.

that must be stored in the vine to assure a favorable start on the following season's activities. Consequently, an abundance of foliage is necessary, and anything that reduces the amount of chlorophyll-bearing tissue, whether it be summer pruning, attacks of injurious insects, or fungus diseases or other plant pests, hinders by that much the normal functioning of the vine. If such injury is pronounced, the fruit fails to mature properly, and the vine is weakened. If the injurious treatment is long-continued, the vine may die. Judicious pruning while the vine is still dormant will ordinarily keep the following season's growth within reasonable bounds and assure sufficient foliage to meet all needs, provided diseases and pests are held in check.

HOW TO PRUNE

As indicated above, detailed procedures followed in the pruning of grapevines will vary with the system of training used, but in any case the early handling of the young vines is the same.

When the young plants² are received from the nursery they have one or more canes of the previous season's growth (fig. 19). Before the plant is set in the ground, selection should be made of the most vigorous cane; this should be cut back or pruned so as to leave only 2 or 3 good eyes, or buds, and the other canes removed entirely. In the selected cane the cut should be made 1 to 1½ inches above the upper bud, but the discarded canes should be severed close to the main stem (fig. 20). This favors prompt healing and tends to prevent the development of suckers. Where roots show frayed ends or badly injured surfaces, they should be pruned away so as to leave clean wounds.

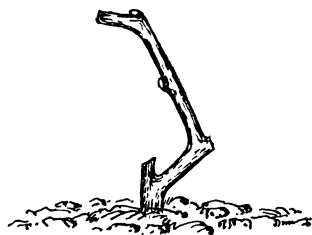


FIGURE 20.—A young vine set in the ground. Note that two buds are left above ground.

During the first season the young vine is allowed to develop naturally, the only training required being to tie the new growth to a lath or stake to permit cultivation without injury to the young canes.

After the vine has been 1 year in the vineyard, unless it has made exceptionally vigorous growth, it should again be cut back at pruning time, leaving, as before, two or three good buds on the strongest cane. To the beginner this may appear unwise, but experience has shown that the development of a strong vine is more certain where this procedure is followed than where a small cane of the first season's growth is used to form the main trunk of the vine. From this point on, the pruning and training operations should be made to suit the needs of the particular system followed.

TRELLISING AND TRAINING

Plans for the type and exact location of the trellis should be made before the young vines are set in the ground. It may be constructed at once, but it is not essential to do so before the second season. The position of posts, however, should be determined in advance, so that the plants may be properly spaced and the later establishment of the trellis will not interfere with their development. The trellis should be erected while the vines are dormant, as then there is less

² Vigorous 1-year-old plants are to be preferred to those 2 or 3 years old.

likelihood of injury to the young plants. Once the trellis is in place the new shoots as they develop may be trained to suit requirements.

Three types of trellises and appropriate pruning and training systems for each are described in the following paragraphs. This discussion by no means covers the entire field of grapevine pruning and training. Rather, an endeavor is made to make clear the principles on which the intelligent pruning of grapevines is based and to indicate some of the ways in which the training may be done to give best results. It is important to remember that grapevines must be pruned if they are to prosper and yield satisfactorily, that the fruit is borne on growth from canes produced the previous season, and that the degree of pruning given a vine must be suited to its individual needs.

Four-Cane Renewal System (Kniffin)

The four-cane renewal system has a number of advantages and is becoming increasingly popular. It is well adapted to small home plantings and equally suited to large-scale commercial vineyards. The trellis is simple and easily constructed, and once the pruning has been done and the canes tied to the wires the manual labor involved in the growing of the crop is reduced to a minimum. Cultivation of the vines is also facilitated, and they are readily accessible for spraying and the harvesting of the fruit.

The Trellis

The trellis consists of two horizontal wires stretched between and attached to posts that have been set firmly in the ground. The posts should be of decay-resistant wood or of wood impregnated with creosote. Galvanized-iron fence posts are satisfactory and more permanent, but may be too expensive. In the choice of posts it should be remembered that the trellis is to serve for many years; and, as the replacement of posts is rather difficult after the vines are well established, durability is a very important matter in their selection. A distance of 20 feet in the row is about the right spacing, but this may be varied a little to meet specific needs. A distance of 8 feet between rows may be used with small plantings, but for larger scale operations where tractors and large spraying equipment are required a spacing of 10 feet is much more satisfactory.

For some grape varieties, posts 8 feet long and 5 to 6 inches in diameter at the small end are adequate. They should be set in the ground, large end down, to a depth of at least 30 inches. Before the wire is stretched, the end posts should be either braced and stayed from the inside or stayed from the outside by guy wires, secured to deeply buried weights, or deadmen (fig. 21). Interior bracing has the advantage that the trellis is entirely confined within the limits of the end posts and cultivation of the vineyard and care of the headlands are not impeded by exposed guy wires. Where this is not a consideration, guys are satisfactory and have the advantage of greater permanence. All braces should be of decay-resistant material and of sufficient dimensions to give full and permanent support to the end posts.

Smooth No. 9 galvanized wire is best for trellis construction, but No. 10 and even No. 11 wires are sometimes used. Black wire rusts too quickly. With the four-cane renewal system, two strands of wire are used, the lower attached to the posts at a distance of 30 inches

from the ground and the upper at a height of about $4\frac{1}{2}$ feet. Each wire is wound around the end posts and secured by a few turns upon itself. Heavy galvanized fence staples are used to support the wires on the interior posts. These are driven in far enough to give full support to the wires but with enough free space provided to permit subsequent tightening of the strands. The wires should be attached on the windward side of the posts and should be tightened from time to time as they become too slack to give full support to the vines.

Training the Vine

After the trellis is constructed, a lath or stake is placed by each vine and tied to the lower wire at its upper end. As the new growth develops, the strongest shoot is tied to this stake and the others are completely removed. During the rapid extension of the growing shoot tying will need to be repeated occasionally to assure a straight trunk for the vine. If growth is vigorous, the vine may reach beyond the limit of the stake, in which case a cord extending from the lower to the upper wire will serve as a satisfactory support. Strong plants

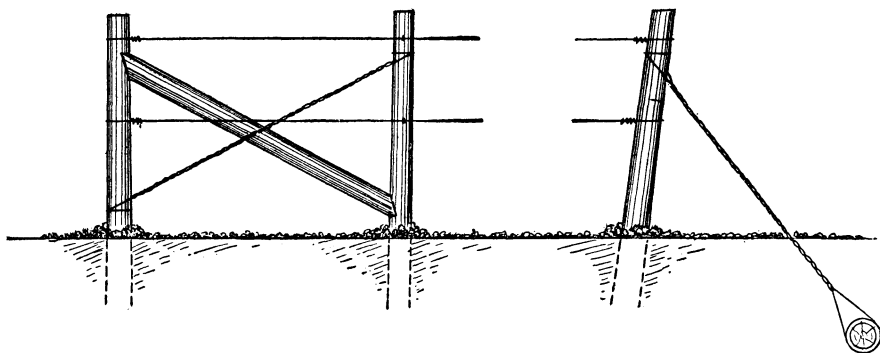


FIGURE 21.—Two methods of bracing and anchoring end posts in the vineyard.

will often grow to the top wire or above during this second season. Suckers or sprouts that develop at or near the ground level should be removed promptly, but no other pruning is necessary or desirable during the growing season.

During the following winter or early spring when the pruning is done, all side shoots should be removed from the trunk of the vine below the first wire except those nearest to it, taking care to sever them close to the trunk so as to discourage later growth from these points. One cane on each side close to the trellis wire is pruned so as to leave not more than four buds and then is tied to the wire. If the previous season's growth has gone beyond the second wire and strong lateral branches have developed in this region, these are pruned back to one or two buds each and tied to the wire. Excess growth above and any lateral growth on the trunk between the two wires is pruned away. Usually, however, the growth above the first wire is not sufficiently vigorous to permit the complete formation of the four-cane vine at this time; instead, the main stem exceeds the height of the top wire by a short distance. In this case the lateral growths above the first wire are pruned away, the stem is tied to the upper wire in a

vertical position, and the terminal end is pruned back to leave 8 to 10 inches of growth above the wire. This is then carefully bent over and tied to the wire. Shoots developing from the buds nearest the head of the vine will form canes for the following season. With the vines that have not made sufficient growth to form a good head it is advisable to cut back the stem to a point near the lower wire and wait for a vigorous shoot of the following season's growth to form the upper trunk of the vine. In this case the laterals at the first wire should be allowed not more than two buds each.

In tying vines and canes to the trellis, it must be remembered that its purpose is merely to hold the vine in position, and care should be taken that the cord is not tight enough to interfere with the flow of sap and the normal increase in girth of the vine. Cord used in securing the trunk and head of the vine to the trellis wires should be renewed each season at pruning time. A number of different materials are used in tying, but a 16-strand, soft cotton twine is very satisfactory.

The vine should be tied to the wires on the side opposite the direction of the prevailing wind; otherwise it is likely to be injured by chafing.

During the third season vigorous vines will usually blossom and set some fruit, but not more than a few clusters should be allowed to develop. It is better to hold back bearing until a strong vine has been established. Training the vine for this season will consist in removing shoots from the trunk between and below the wires and any suckers that may spring from the crown at the ground level, and the tying in of canes desired to be laid on the wires the following season. If all has gone well up to this point, the vine should be in condition to bear an annual crop of fruit, and subsequent pruning and training should be done with this in mind (fig. 22).

Before the details of the next pruning operations are given, it may be well to state the basic ideals. First, with this system a strong vine having a straight vertical trunk with four fruit-bearing canes supported on the trellis wires is desired; second, four one- or two-bud spurs, two at each wire level and as close as possible to the trunk of the vine, are required as sources of shoots for the following season's fruiting canes; third, the proper number of buds on the fruiting canes to assure satisfactory maturing of the fruit and a normal increase in vine size. If too many buds are left on the pruned canes, a vine will tend to overbear and produce fruit somewhat inferior in size and quality. On the other hand, if too few buds are left, there is a tendency for the vine to become overvegetative, forming what are known as bull canes, and the crop of fruit is smaller than it should be. Obviously the severity of pruning will depend on the present condition of the individual vine. If it is strong and vigorous more fruiting buds may be left than on a vine of the same age that has less vigor.

Pruning the Mature Vine

With the basic ideals in mind, selection is made of the four canes that are to bear the present season's crop and of those that are to be cut back to one- to two-bud spurs. Both fruit-bearing and spur canes should arise from as near the main trunk and head of the vine as possible. The best canes for bearing are those about one-fourth inch in diameter, though there may be some deviation from this rule with

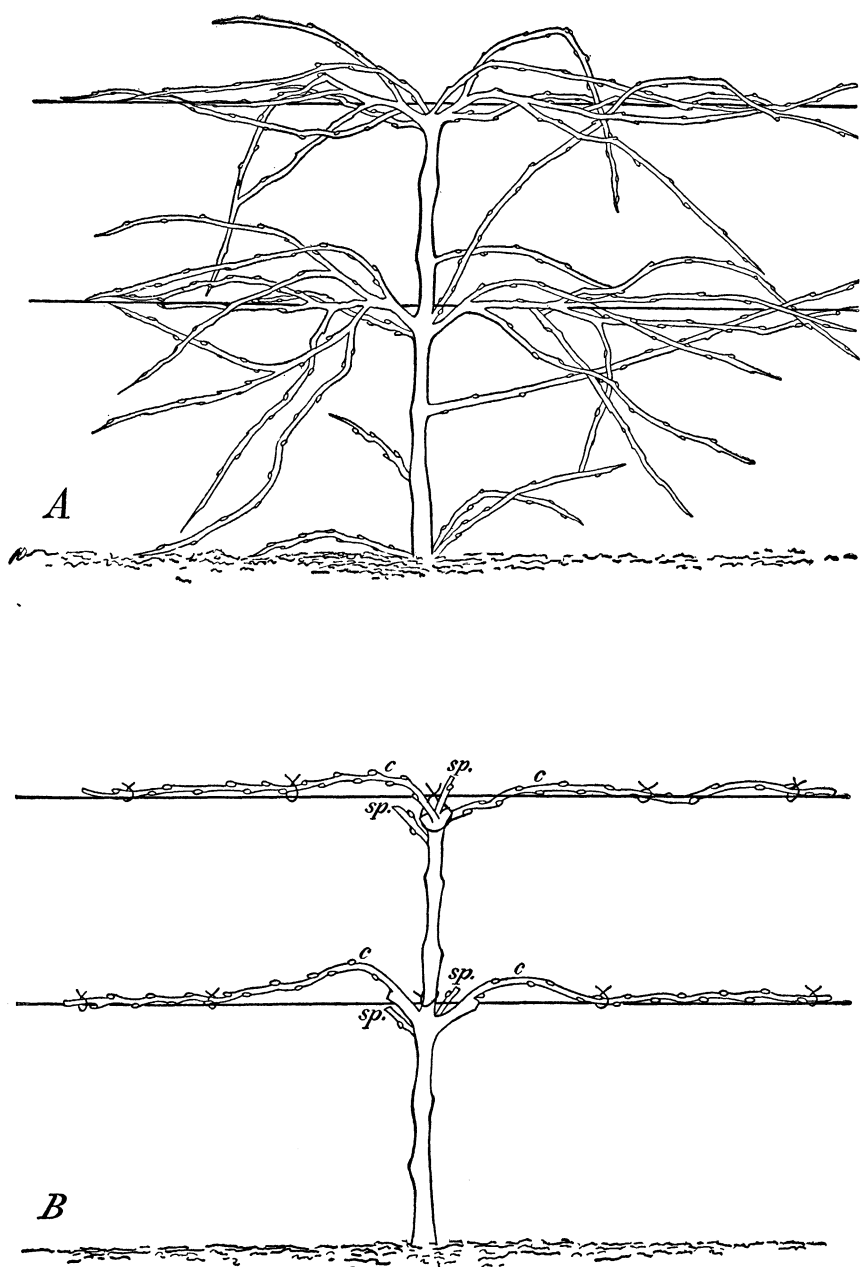


FIGURE 22.—A mature dormant vine (A) before pruning and (B) after pruning according to the four-cane renewal (Kniffin) system. *Sp.*, renewal spur; *c*, fruiting cane.

varieties whose fruiting canes normally are larger or smaller than the average. Oversize canes should not be selected for fruiting but may be used for spurs.

If canes of suitable size are not available and the oversize ones must be used or none at all, then it is best to use the smaller side branches of the large cane as the source of fruit buds. When these selections have been made, all other wood produced the previous season is pruned away, the cuts being made close to the trunk. Care must be taken in removing the severed wood that injury is not done to the remaining canes. In cold weather particularly and with some varieties, the canes are very brittle and may be injured easily. It is always best, therefore, to pull away the discarded wood in the direction of the extremities of the vine rather than toward the trunk.

The next step is to cut back the spur canes to within one or, at most, two buds from the trunk of the vine and remove the severed canes. This leaves the four fruiting canes to be pruned. It must be noted that the number of buds on the cane rather than the length of the cane is the important consideration. The canes of different varieties of grapes differ in the length of the internodes, the buds in some varieties being much closer together than in others. Pruning to equal length might result in the one case in underpruning and excess fruit production, and in the other in overpruning with its attendant evils.

The number of buds left for the production of fruit should be distributed as equally as possible among the four canes. The bud at the base of the cane is not counted, as ordinarily this does not produce fruit. Because the amount of fruit a vine may bear properly varies with its vigor and because the maturity and the fruiting habits of different varieties vary also, it is not possible to state just how many buds should be left on the fruiting wood in any particular case. However, it may be said, as an example, that in pruning a normal mature vine of the Concord variety from 40 to 60 buds should be left, depending on the condition of the vine. With young or weak vines, the number is correspondingly smaller. From this point on, the principles just set forth apply in the care of the vine from year to year.

In case of injury to or death of a part of the vine, renewal may be effected, provided the root system is healthy, by pruning the dead or injured part back to healthy wood and training a new shoot to take its place. Renewal of old vines may be accomplished in this way, the new shoot in this case being brought up preferably from the ground level.

Three-Wire Canopy System (Munson)

The three-wire canopy system, or some slight variation of it, as originated by the late T. V. Munson, has been found particularly adapted to the warmer and more humid sections of the country, where fungus and insect pests are prevalent and sun-scalding of the fruit on the vine is likely to occur. It is equally well adapted to home and small-scale plantings and large commercial vineyards.

The system has the advantages of providing greater freedom of air movement about the vines, more ready access to the under side of vines and foliage—a very important consideration where constant warfare must be waged with diseases and pests—and greater protection to the fruit from injury because of the canopylike arrangement of canes and foliage. Of additional advantage is the ease with which movement may be made from row to row or from one part of the vine-

yard to another during vineyard operations. The trellis is somewhat more expensive and difficult to construct than the two-wire type already discussed, but once it is in place upkeep and care are but little greater. For many, the advantages of the system far outweigh the difference in cost and maintenance.

The Trellis

The statements made relative to the character of posts, their spacing and installation, and the kind of wire to use for the two-wire type of trellis (p. 28) also apply here. In arranging for the support of the vine, however, three wires instead of two are used (fig. 23). The lower wire may be attached to the posts in the manner already de-

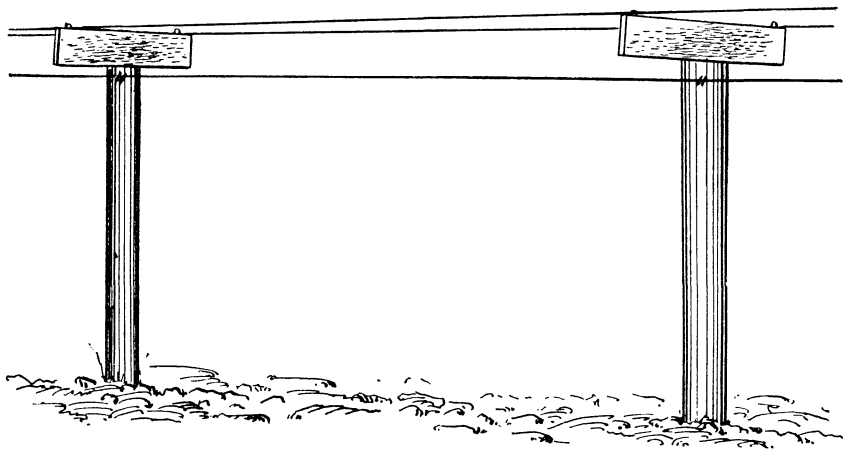


FIGURE 23.—Construction of the trellis for the three-wire canopy system (Munson) for grapes.

scribed or it may be passed through suitable holes bored through the posts in the direction of the row. Its height above the ground should be $4\frac{1}{2}$ to 5 feet. The other two wires are supported near either end of cross arms, 2 feet long, fastened to the post at a height of 6 to 8 inches above the lower wire. Creosoted two-by-fours serve well for cross arms, and these may be fastened to the posts, where mortises have been made to receive them, or spiked to the top after the posts have been squared off at the proper height. The wires may be passed through holes bored 18 to 20 inches apart in the cross arms or held in place by staples as desired. Installation of the last two wires may be delayed until the vines have reached the first wire, but if this is done the vines should be dormant and great care should be taken that they are not injured in the process. The wires should be occasionally tightened as they become slack, as described on page 29.

Training the Vine

The trellis system calls for a strong, straight, vertical trunk reaching to the height of the first wire before any branching is permitted. The head of the vine is formed at the first wire and lateral canes from this point are laid out, one in each direction, and tied to the wire. The

new side shoots from these canes are supported by the two horizontal wires above, and, as they develop, form a canopy from beneath which the fruit clusters are suspended. Therefore, the first consideration is the formation of the trunk of the vine. This is accomplished either by tying the selected shoot to a stake as before, or, if this is not feasible, by driving a short stake into the ground near the vine, stretching a strong cord from this to the first wire and training the developing shoot to this cord. The formation of side branches is usually discouraged by pinching back the very young tips as they develop, so that maximum growth is confined to the main shoot. Strong vines should reach the wire in one season; but, if none do, it is necessary at pruning time to cut back the stem and await the development during the next season of a strong shoot to go to the wire and form the head of the vine. When the wire is reached, the tip is pinched off and the side branches as they develop are tied to the wire in each direction. No additional summer pruning is practiced other than the removal of water sprouts and suckers.

At the next pruning season any side canes that may have developed on the trunk below the head are pruned away and two fruiting canes and two spur canes arising at the head of the vine are selected (fig. 24). All other growth is removed. The two spur canes are cut back to one or two buds to provide for renewals and the fruiting canes pruned to leave not more than four buds each for this first fruiting season. The head of the vine is held to the wire by a loose support, and the canes are tied as before. Some fruiting of strong vines may be expected this season, but fruiting should be confined to a few bunches by judicious removal of excess clusters to favor the strong vegetative growth of the vine.

Pruning the Mature Vine

In successive pruning operations the same principles are observed as already discussed (pp. 30-32). The fruiting canes and spurs are selected as close to the head of the vine as possible, and the number of buds left are increased as the vine becomes older and better established. With very vigorous vines, two fruiting canes may not supply enough buds to meet the needs of the vine, in which case two canes on each side may be used instead of one. Frequently suitable spur canes are not found at pruning time at the head of the vine, and the grower is obliged to depend on shoots developing near the base of the fruiting canes to furnish spurs at the next pruning season. Long arms formed from canes more than 1 year old are to be avoided, and whenever necessity requires their use they should be cut away at the earliest opportunity in subsequent pruning.

Arbors and Pergolas

Growing grapes on arbors and pergolas in the garden and about the home calls for a brief discussion on the development and maintenance of the vines grown in this fashion. The arbor may be as simple and inexpensive or as pretentious as desired. Its design is a matter of individual choice and need not be considered here. There are, however, a few practical matters to be taken into account when a unit of this type is established because the welfare of the vines and consequently the satisfaction to be derived from their culture in this way depend on the observation of certain cardinal principles.

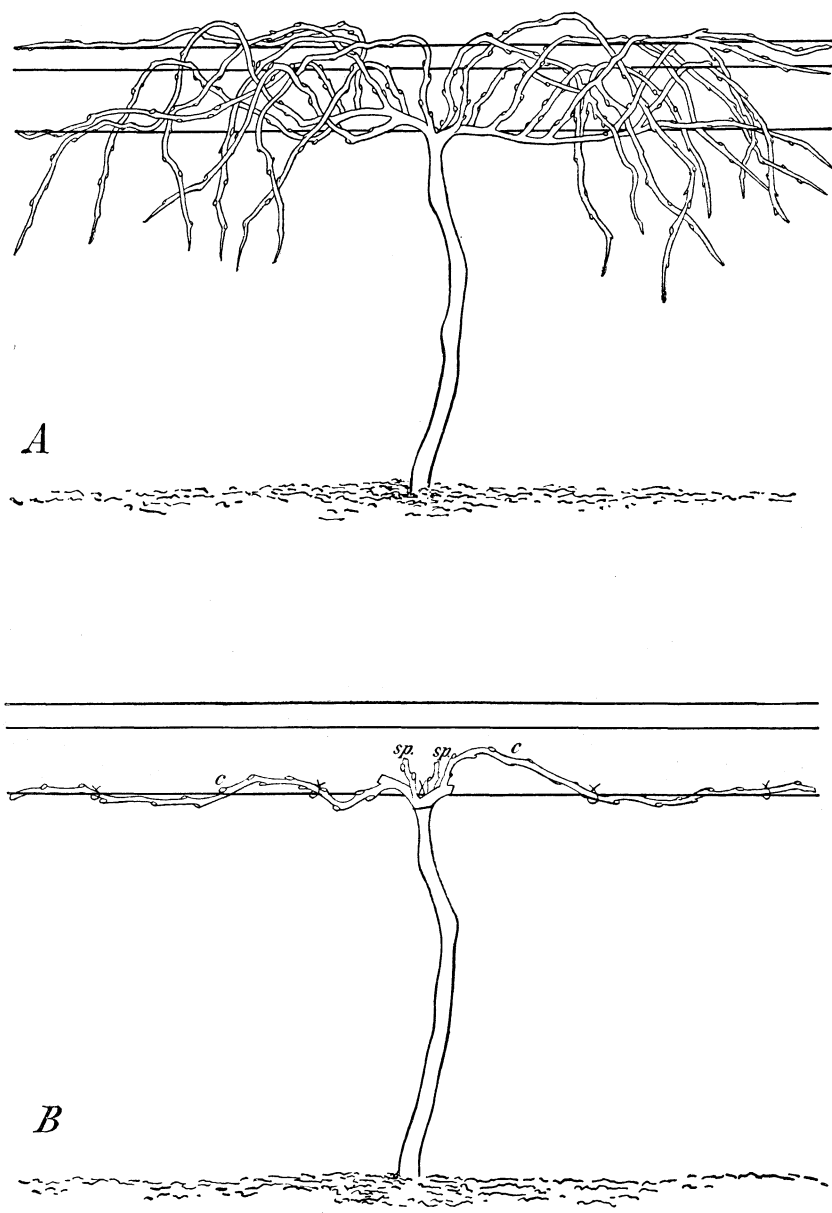


FIGURE 24.—A grapevine growing on the three-wire canopy trellis (A) before pruning and (B) after pruning. *Sp*, renewal spur; *c*, fruiting cane.

Grapes thrive only where there is an abundance of sunshine; they require cultivation and spraying as well as pruning and training if they are to prosper. They normally live for many years, and when well cared for their value increases with time. In planning for the grape arbor, therefore, the site should be selected with care. Provision should be made so that the cultivation, pruning, training, and spraying may be done with ease and convenience. Not merely design but permanence should be considered in the construction of the arbor, and only those materials should be employed that permit long-time use with a minimum of repair. Wood, metal, masonry, and combinations of these are all appropriate. One recommendation only is made, namely, that the use of wire mesh be avoided. It makes an excellent support for the vines, but it makes pruning and training operations extremely difficult.

Proper arrangement of vines about the arbor or pergola depends to some extent on the size and character of the support but more so on the natural growth habits of the selected varieties and the system of training to be followed. For most varieties the vines should be separated by at least 6 feet; too close spacing results in the dense interlacing of growth that interferes with satisfactory fruiting of the vine and favors the development of fungus diseases. Suitable pruning is also made much more difficult, and injury to the vine during pruning operations is more likely.

The handling of young vines has already been considered (pp. 27-30) and training and pruning for the arbor may now be discussed. Any one of several systems may be used, the individual merits of which for the present purpose depend on the use to which the arbor is to be put. If shade is the sole consideration, treatment will differ from that given if the production of fruit is of prime importance. It is assumed, however, that a combination of both is the end sought.

The Fan System

One of the best systems for use with the arbor or pergola is the so-called fan system in which the vine instead of being trained to a single trunk is allowed to branch a short distance above the ground, and these branches are trained into a more or less fan-shaped arrangement to form the skeleton of the vine (fig. 25). This is readily accomplished. After the young vine that has already been in place for a year has again been cut back to two or three buds at pruning time, the strongest shoot as it develops is selected (see pp. 29, 47) and tied to a suitable support. It is allowed to grow to the height at which branching is desired, and the tip is then pinched off. This results in the formation of side branches, the strongest of which are selected for training and all others are removed. The direction in which the growth is permitted to go is carefully controlled by tying the growing shoots to the arbor in the desired positions. Because in this system there are several growing stems instead of one, as in the other systems mentioned, it is not to be expected that the entire vine skeleton can be realized the first season of training. The final form will be obtained by cutting back sufficiently at pruning time to assure vigorous shoots the following season which, in turn, are selected and trained as with the other systems.

Pruning fruiting vines trained in this way will be influenced somewhat by the number of branches and their nearness to each other as

well as by the vigor of the vine. As with the other systems discussed, the number of buds left at pruning time, as well as the length of the fruiting canes, should be determined in relation to the maturity and vigor of the vine. Long fruiting canes may be used, but their numbers will necessarily be few. It is believed that a larger number of short canes will be found much more satisfactory. This is known as "spur pruning," the spurs in this case having two to four buds arising from points as near the main vine as possible. In all subsequent pruning

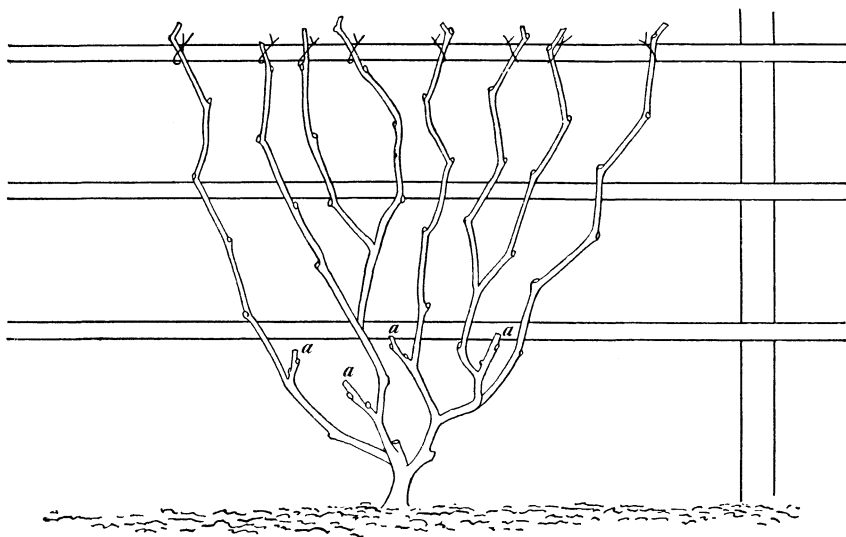


FIGURE 25.—A vine pruned and trained on an arbor according to the fan system. Note renewal spurs (a).

this relationship of spur to vine should be maintained. From this point on, procedures will conform to the principles already discussed.

Horizontal-arm Spur System

Another procedure well adapted to training grapes on the arbor is known as the horizontal-arm spur system. With this the early training of the vine is the same as in the fan system just discussed, but instead of several branches only two are trained in a horizontal fashion at any height desired (fig. 26). When these have reached the required length, the tips are pinched off and the lateral shoots allowed to develop at the nodes. From these shoots are selected those to be used for vertical training and all others are removed. They may be brought up and over the top of the arbor in regular fashion or the training modified as desired. At pruning time these vertical canes are all cut back to two- or three-bud spurs on the horizontal arm, and from these the following season's new vertical canes and fruit will be derived.

Overhead or Canopy System

Where overhead cover is desired, the canopy system is used. Training the vines is in accordance with the procedure set forth under

the three-wire canopy system except that the head of the vine is formed at the top of the arbor and the lateral growth trained to form a more or less complete network over the surface. It must be remembered, however, that judicious pruning will need to be practiced regularly if satisfactory results are to be obtained. This system, or

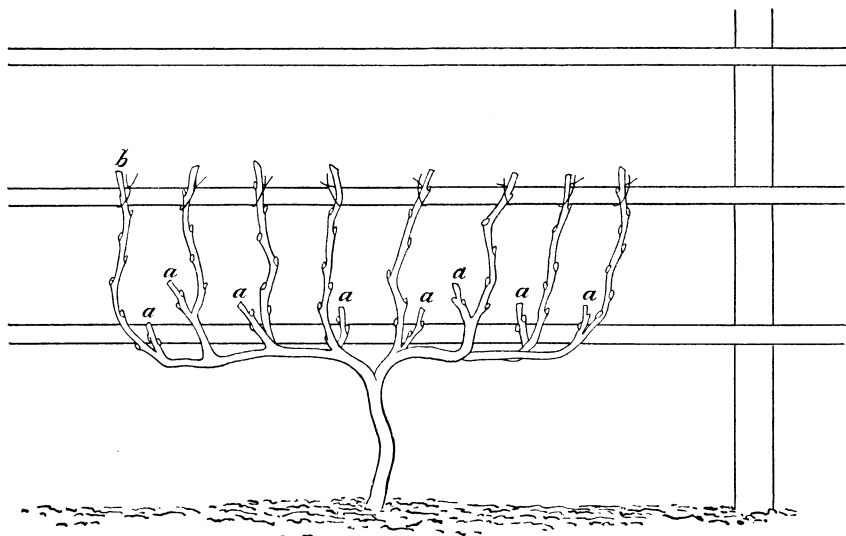


FIGURE 26.—A grapevine pruned and trained according to the horizontal-arm spur system: *a*, Renewal spurs; *b*, fruiting cane.

some modification of it, has been found well adapted to the growing of muscadine grapes in the southern sections of the country.

PRUNING SMALL FRUITS³

CURRANTS AND GOOSEBERRIES

Currants and gooseberries naturally form bushes with many stems starting out both near and below the surface of the ground (figs. 27, A, and 28, A). More stems are usually formed than should be retained, and unless the older ones are removed the bushes become too dense. Pruning consists primarily in removing the superfluous stems and those more than 3 years old. Only rarely are the branches headed back. The pruning may be done any time during the dormant season from leaf fall in the autumn until growth starts in spring. The fruit is borne on 1-year-old branches and on 1-year-old spurs on older stems. One- and two-year-old bushes should have only the weaker stems removed with the object of getting about 9 or 10 vigorous stems by the end of the third year. Thereafter all stems more than 3 years old that have passed their most productive stage should be cut off close to the ground. The lower branches that may bend over into the soil should also be removed. Figures 27 and 28 show a currant and a gooseberry bush before and after pruning.

³ For more detailed information in regard to pruning, see Farmers' Bulletins 887, Raspberry Culture; 1398, Currants and Gooseberries.

BLUEBERRIES

The blueberry produces fruit on wood of the previous season's growth. The largest fruit is borne on the most vigorous wood. Most varieties tend to overbear and, unless part of the fruit buds of such varieties are pruned off, the berries are relatively small. The purposes of pruning, therefore, are to obtain vigorous new shoots each year and to reduce the number of fruit buds so that the greatest quantity of large berries can be obtained year after year. If the plants are heavily fertilized and the soil moisture supply is adequate at all times, the plants make much stronger growth and can produce a much heavier crop of large berries than if fertility is lacking and the soil-moisture supply insufficient at times.

Usually little pruning is necessary for the first 3 years. At the end of the third season regular annual pruning should ordinarily begin. This consists of cutting out the low spreading branches next to the

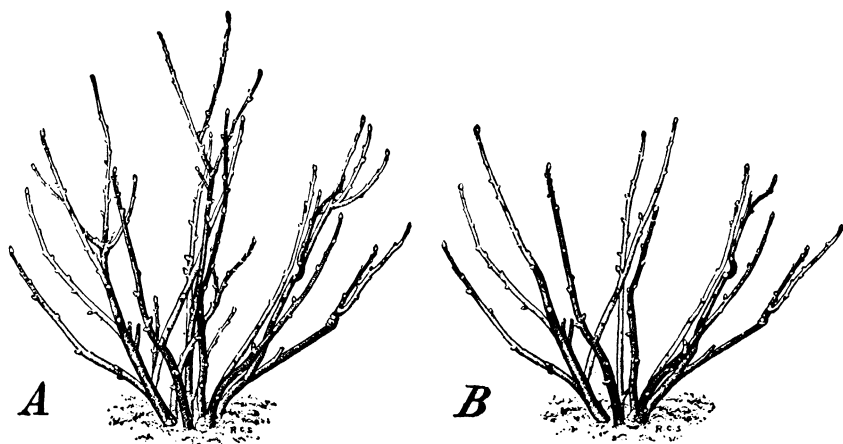


FIGURE 27.—A currant bush (A) before and (B) after being pruned.

ground, leaving only the erect branches or shoots. If the center of the bush is dense, the weak and the older branches at the center should be removed. The erect-growing varieties, such as Earliblue, Pemberton, Jersey and Ivanhoe, need to be thinned at the center, whereas Murphy is spreading, and the lower drooping branches may need to be removed. Most of the slender small branches should also be removed, leaving the strong branches and shoots. A great many of these slender branches do not bear fruit buds, and if they do the buds are weak. Furthermore, these weaker branches make the bush so dense that picking is difficult. They also prevent the growth of strong new shoots. Finally, depending on the number of fruit buds, the fruiting shoots of some varieties should be cut back in order to thin the crop. Earliblue, Pemberton and Ivanhoe require little cutting back; Scammel requires cutting back to about three to six fruit buds per shoot. The amount of heading back necessary varies from year to year, depending on growing conditions. Pruning may be done at any time from leaf fall in the autumn to the beginning of growth in the spring.

RASPBERRIES, BLACKBERRIES, AND DEWBERRIES

The fruit of the brambleberries, (raspberries, blackberries, and dewberries) is produced on canes that grow in one season, fruit the second season, and then die (except the Himalaya blackberry in California).

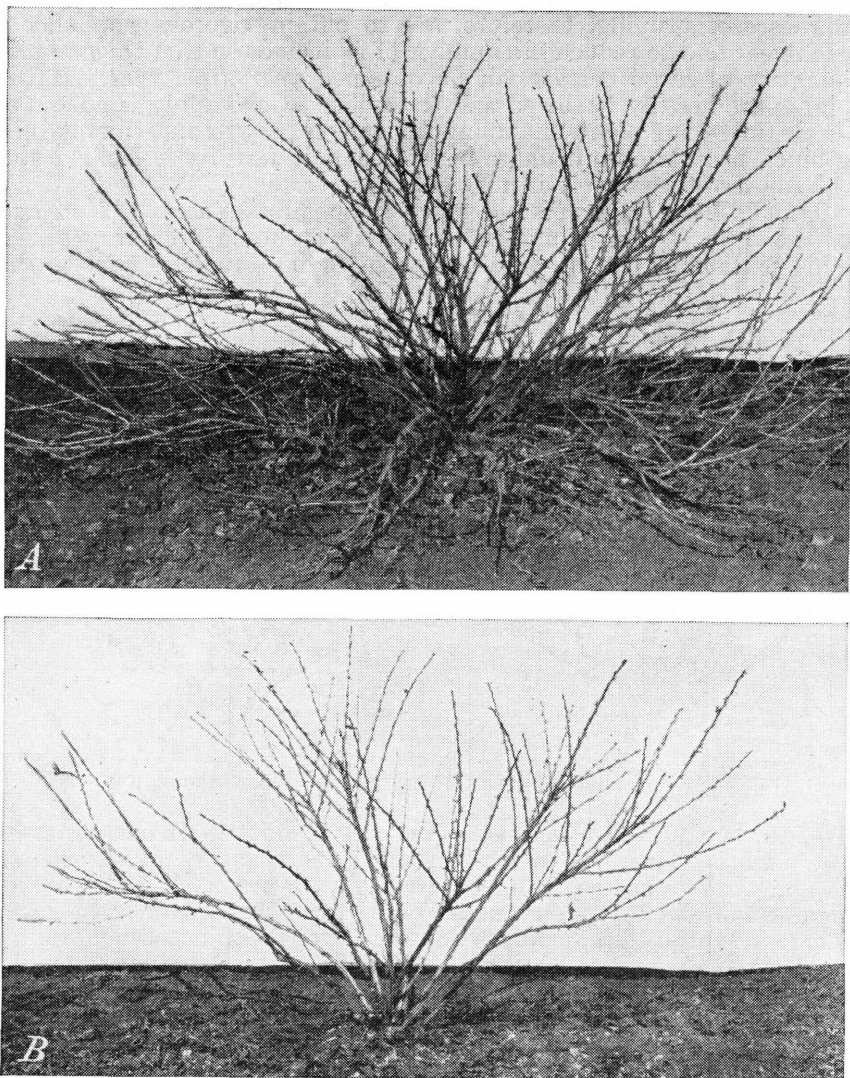


FIGURE 28.—A very vigorous gooseberry bush (A) before and (B) after being pruned. The branches lying on the ground were removed and the top was trimmed.

Therefore, all the second-season canes should be removed as soon as possible after the fruit has been picked, in order to give room for the new canes to develop. The additional pruning required depends on the habit of the variety and the method of training used.

The black and purple raspberry types have arched canes that root at the tips in autumn, and the varieties now in the trade do not sucker. Because they normally set far more fruit than the canes can develop to large size, all varieties of the black and purple raspberry are pruned heavily, the type of pruning depending on the training system used. If the canes are to grow without supports, the tips of the young shoots of the black varieties are pinched off when they are from 12 to 24 inches high and those of the purple varieties when they are about 30 inches high. The shoots then branch low and do not become so top-heavy when loaded with berries as they would otherwise. Just before growth starts the following spring the side branches are cut back. The fruit is borne on new growth coming from buds on the laterals. The number and size of the berries can be controlled by the number of buds left. If the canes are small, 2 buds per lateral are enough; if the canes are very vigorous, 8 or 10 buds can be left. Figure 29 illustrates the method of pruning both black and purple types.

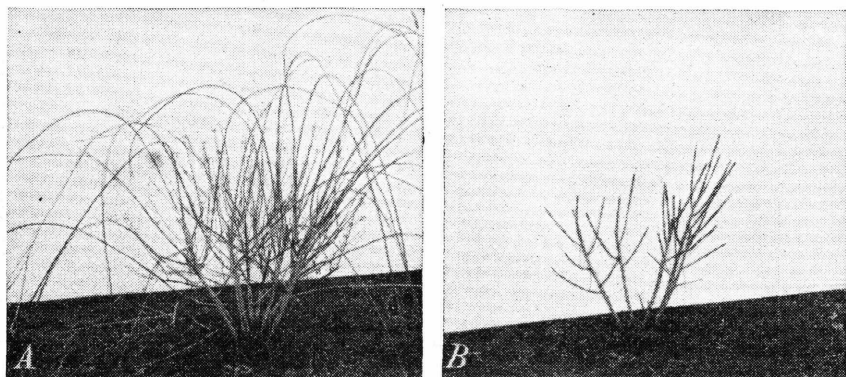


FIGURE 29.—A black raspberry plant (A) before removal of old canes or thinning or pruning, showing laterals rooting at the tip, and (B) after removal of old canes and pruning, with each lateral branch left 6 to 8 inches long. When the canes are more than one-half inch in diameter and the laterals are thus pruned back heavily, plants bear maximum crops of large berries.

These varieties are rarely trained to wire trellises or to posts. When they are, the shoots need not be tipped to make them branch. However, thinning out the weaker canes and cutting back the ends of canes will be necessary in late winter to reduce the number of buds.

Red raspberries have erect growing canes and produce suckers from the roots. Usually they do not need much pruning back except on the Pacific coast. No pinching back to induce branching is desired except under special conditions in southern California. Pruning, other than cutting out the canes that have fruited, in all sections except southern California consists chiefly in thinning out the small and extra canes. In western Oregon and Washington the better growers do most of the thinning of the young canes in April and May when the field is hoed. If an average of seven canes per plant is desired, all but about eight of the new shoots are taken out, the extra shoot being left in case of an accident; the following winter this remaining extra cane is removed. Strong plants may have eight or nine canes left; weaker ones should have but five or six. In the Pacific Northwest

the canes are cut back in the winter to from 4 to 5½ feet, depending on their vigor. Very strong plants can be left with taller canes than weaker plants. A wire trellis with the wires 3 to 5 feet high is used to support the canes (fig. 30).

In central and eastern States the plants are usually grown in accordance with either the hill or the hedge system. Under the hill system the plants are set about 5 feet apart each way, a stake is placed by each plant, and the canes are tied to the stake. Pruning consists in removing all but about seven of the strongest canes per plant (fig. 31).

Where the plants are allowed to form a solid row or hedge 1 to 3 feet wide, pruning consists in removing the smaller canes and leaving the three or four strongest canes per foot of row (figs. 32 and 33). The canes of the Ranere (St. Regis), however, are slender and four

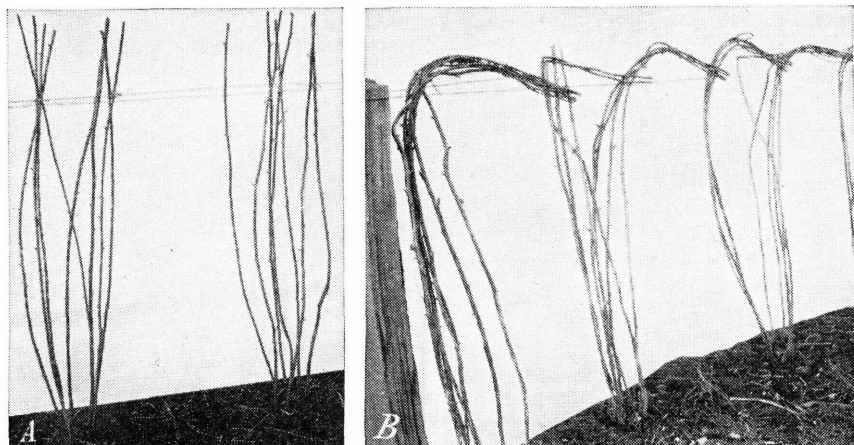


FIGURE 30.—Plants of Cuthbert raspberries under the hill system of culture: A, Two wires, one on either side, hold the canes erect. The wires are about 5 feet above the ground, and the canes are topped about 5½ feet from the ground, which in general has been found the best height where the canes grow tall. B, The canes are arched over one wire, and the ends of the canes of one hill are caught under the canes of the next. The canes are pruned to about 6½ feet. Six or seven canes are left per hill.

or five canes per foot of row may be left. Though the canes of most varieties are cut back only a little if at all, a trellis with wires or binder twine along each side of the row is used to support the canes.

Blackberries and dewberries (or trailing blackberries) are trained according to their growth habit. The erect-growing varieties sucker like the red raspberries and are trained and pruned in much the same manner. They are kept in hills in the Pacific Coast States and in both hills and hedge rows in the Eastern States. The canes are thinned to from five to seven per hill or to two or three per foot of row. In contrast to the red raspberry, the tips of the young canes may be pinched off when they are 24 to 30 inches high. The canes are thus caused to branch more than they otherwise would and are better able to hold up a heavy crop of berries. If the shoots are not pinched off, a wire trellis must be used even if they are pinched back; a wire trellis is often used (fig. 34) to hold the canes erect at fruiting time. The Eldorado, Early Harvest, Lawton, and others of the

erect-growing type are commonly trained in this manner. They are also grown without the trellis support, but often some fruit is lost by the branches bending over to the ground.

Pruning should be done in late winter and should consist in shortening the lateral branches, the extent depending on the habit of the

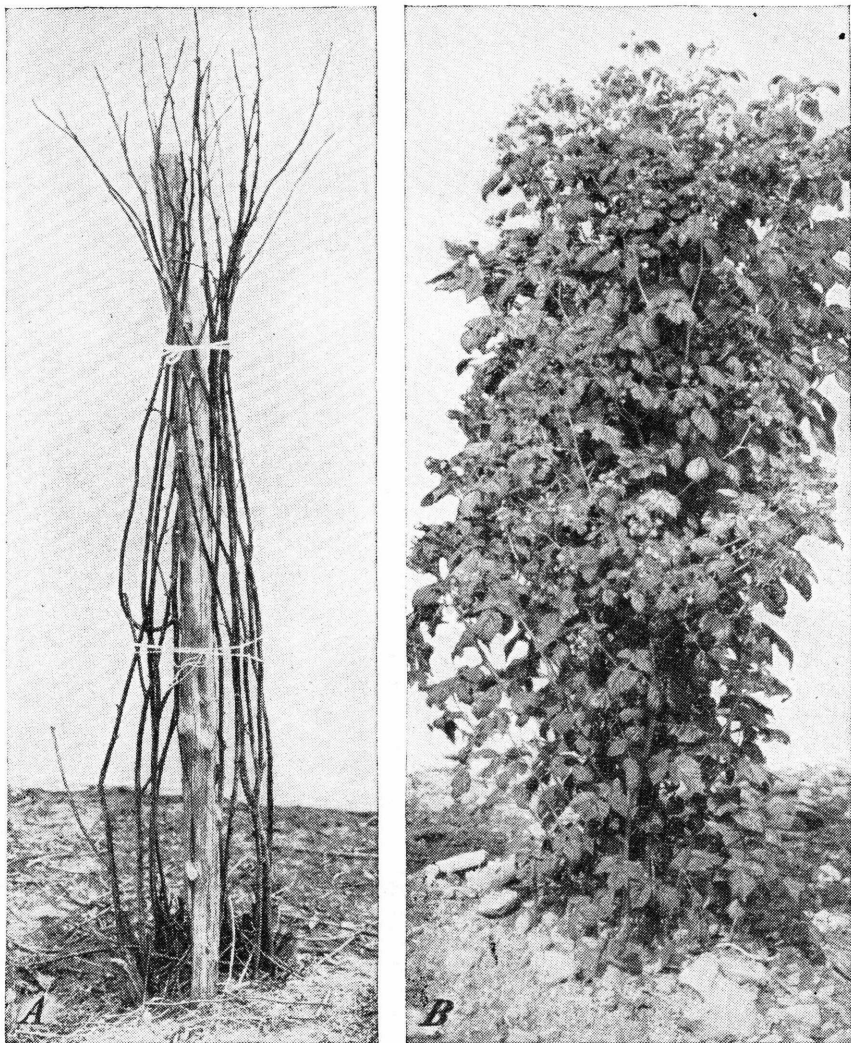


FIGURE 31.—A red raspberry plant grown in accordance with the hill system, the canes being trained to a stake. Seven canes have been left for fruiting. *A*, After pruning; *B*, at fruiting stage.

variety in making fruit buds. If the fruit buds are produced near the base of the lateral, it may be pruned to leave three or four buds, but if the buds toward the base of the lateral are not fruit buds then the laterals must be left long enough to provide for three or four fruit buds. The Lawton, Early Harvest, and Ward blackberries



FIGURE 32.—A field of Marlboro red raspberries under the hedge system of culture. The rows are about 2 feet wide and the canes are held erect by a 2-wire horizontal trellis. Note the irrigation ditches.

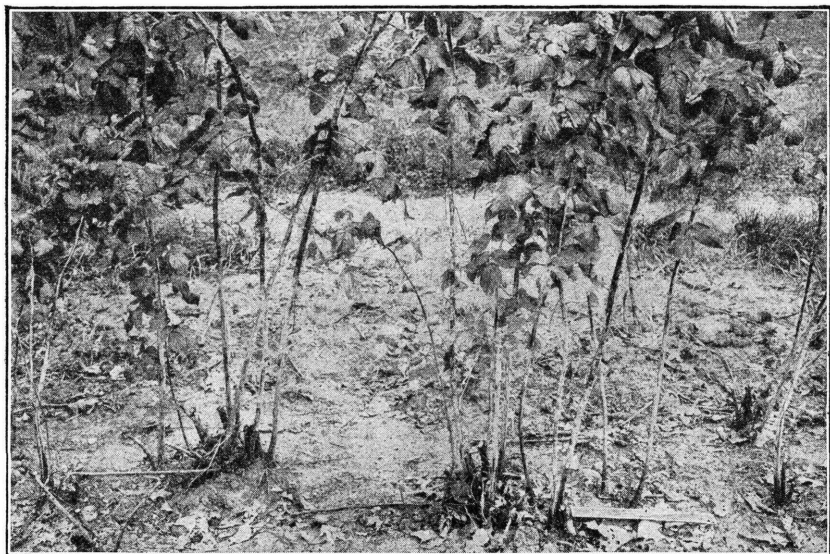


FIGURE 33.—Red raspberries under the narrow-hedge system of culture. The canes are kept in a row about 12 inches wide and are well spaced in the row. They average about three canes per foot of row.

carry their fruit buds well in toward the base of the laterals and well down on the canes. In a test in Illinois, cutting back the laterals of these varieties by one-half did not reduce the crop. The Snyder, Eldorado, and Mersereau blackberry varieties have buds fairly well scattered, and their laterals should also be cut back by one-half.

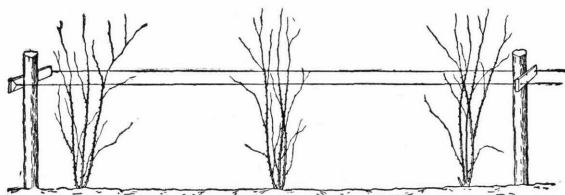


FIGURE 34.—Blackberry canes of the upright type held between two wires.

For varieties having fruit buds well out on the laterals only the tips should be cut off.

The trailing and semitrailing varieties are trained either to stakes or to trellises, the trellis being most common except in North Carolina and southern New Jersey where the Lucretia dewberry is raised (fig.

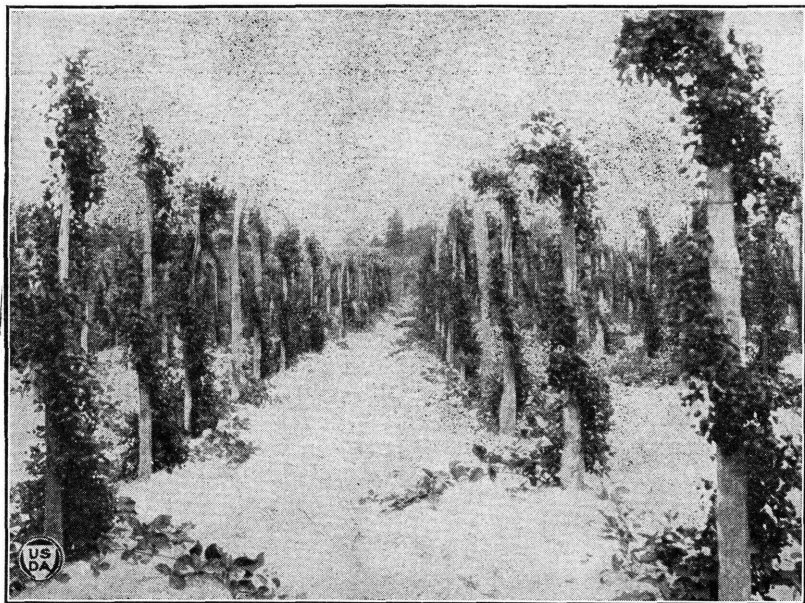


FIGURE 35.—A field of Lucretia dewberries in North Carolina the year after planting, trained to stakes.

35). There a stake is set by each plant, all the strong canes are wound around the stake in a spiral from bottom to top, and the canes are tied to the stake. The stakes used are about $7\frac{1}{2}$ feet long in North Carolina, but only 4 or 5 feet long in New Jersey. The Evergreen (Black Diamond) variety is sometimes trained to stakes in New Jersey.

Pruning, other than cutting out the canes that have fruited, consists in cutting out the extra canes and in cutting off the ends after the canes have been wound around the stakes.

With other trailing varieties and with the Lucretia dewberry in other sections a trellis of some sort is used. The Himalaya, Brainerd, and Evergreen blackberries are very vigorous semitrailing varieties, commonly trained to a horizontal trellis (fig. 36). The Youngberry, Boysenberry, and Loganberry varieties are vigorous but trail more than the varieties just mentioned and are usually trained to a vertical trellis (fig. 37). The Lucretia is less vigorous and unless staked is also usually trained to a vertical trellis.

Pruning these varieties consists chiefly in reducing the number of canes per plant so that it can bear the largest number of berries of large size and still produce enough strong new shoots for the following year. The Himalaya, Brainerd, and Evergreen may have 6 to 9 canes left per plant, and the Young, Boysen, and Logan up to about 15 per plant.

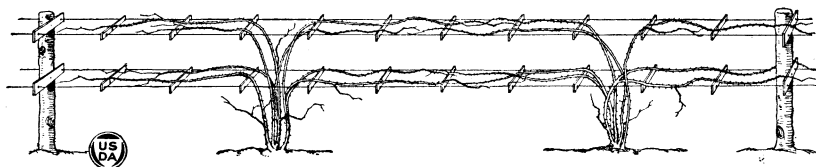


FIGURE 36.—Blackberry canes of the trailing type, trained along four wires. Evergreen, Himalaya, Brainerd, and others of the semierect or very vigorous trailing type are trained to two or four wires, as shown here.

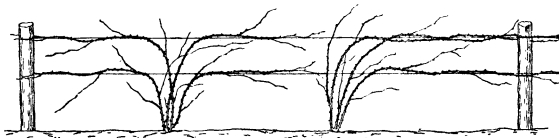


FIGURE 37.—Blackberry canes of the trailing type, trained along two wires. Loganberries, Boysenberries, Youngberries, and others of the vigorous trailing type are commonly trained to two wires.